NSP System: 10-Year Transmission Plan / 20-Year Scenario Assessment

December 2010

This report contains transmission planning data that may be conceptual in nature and is subject to change. The transmission projects listed may change scope or not be constructed

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Purpose and Scope

- The purpose of this document is to present the transmission plans and needs on the NSPM/NSPW integrated transmission system (NSP System) looking forward 10-20 years
- Scope of work:
  - Perform an annual assessment and update of the NSP System transmission assets
    - NERC reliability standards compliance requirements
    - Load forecast (2010) (including wholesale)
    - Resource plan (2010)
    - MN Renewable Energy Standard
    - Regional Delivery of Wind Generation
- Stakeholder input
  - Input on needs and responsive plans are encouraged from stakeholders
  - Plan Subject to Midwest ISO stakeholder process

Executive Summary

- 10-Year Transmission Plan
  - Core Reliability projects assessed (2011-15)
  - States Renewable Energy Standards
    - MN RES 30 % renewables by 2020
    - Wisc RES 10% renewables by 2015
    - ND RES 10% renewables by 2015
    - SD RES 10% renewables by 2015
    - Western MN, eastern ND & SD wind generation major driver
  - Significant sub-regional transmission involvement
    - CAPX 2020 group 1 completion by 2015
    - Corridor and La Crosse- Eastern Wisconsin 345 kV projects 2015-2025 in-service
    - Second Manitoba Hydro 500 kV in MISO TSR for 2017 in-service

Executive Summary, cont.

- 20-Year Transmission Scenario Assessment
  - 20-year scenario assessment is a conceptual vision
  - NSP evaluated 4 Sub-Regional scenarios based on possible upper Midwest (IA,MN,ND,SD,WI) renewable energy policies
    1. High Manitoba Hydro development
    2. Sub-Regional renewable development
    3. Carbon reduction future
    4. Regional 500 kV overlay/high renewable scenario
  - Conclusion
    - 345 kV overlay likely sufficient to meet likely upper Midwest only needs
    - Significant national level renewable exports may drive a different approach
    - CAPX 2020 group 1 good fit with the future scenario developments.

Executive Summary, cont.

- Regional studies and proposals
  - Potential with national RES policy development
  - Wind generation primary driver
  - Regional 765 kV proposals
  - Projects under study proposed by regional entities
    - MISO Regional Generation Outlet Study (RGOS 1 and 2)
    - Green Power Express 765 kV project
    - SMARTransmission Study

Note: NSP is participating in these studies to ensure the NSP System and local area are properly represented and to ensure customer focus, cost effectiveness, operational reliability and regional policymaker alignment.

Key Messages

- 10-Year Plan
  - New load peak in August 2010 shows growth
  - Wind generation continues to be a driver of transmission although development slower than in recent past
  - CAPX 2020 and Corridor project support Minnesota Renewable Goals
- 20-Year Transmission Scenario Assessment
  - 20-year scenario assessment is a conceptual vision for the NSP area
  - NSP evaluated 4 unique transmission scenarios
  - Scenarios include various levels of renewable energy, and varying potential upper midwest environmental policies

Key Messages

- Regional Studies and Proposals
  - Wind potential in Dakotas, Iowa and Minnesota is one driver for interest in Regional 765 kV transmission development
  - NSP engaged in regional and national efforts to broaden policy considerations
    - Support for renewable energy
    - Incorporate potential climate change policy impacts
    - Evaluation of various export strategies
    - Assure coordination with NSP transmission system

Note: NSP is participating in these studies to ensure the NSP system and local area are properly represented and to ensure customer focus, cost effectiveness, operational reliability and regional policymaker alignment.

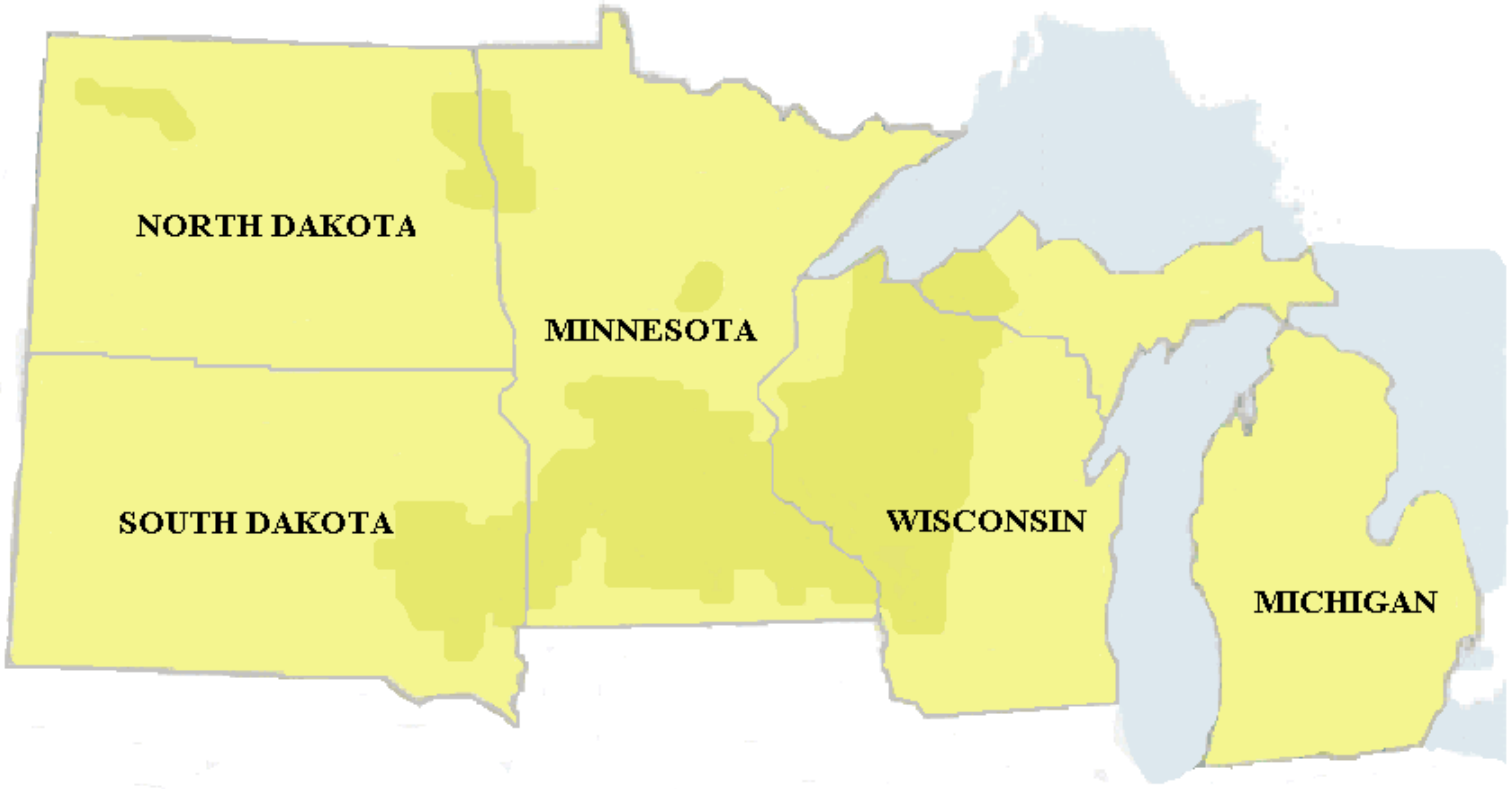
NSP System Statistics: 2010

- 7,153 miles of transmission (34.5 kV and above)
- 477 substations served
- 7,570 MW Xcel Energy-owned generation
- 1,292 MW Wind generation
- NSP System Previous Peak Load: 9,027 MW (Actual) (July 2006)
- NSP System Peak Load 9,125 MW (Actual) (August 2010)

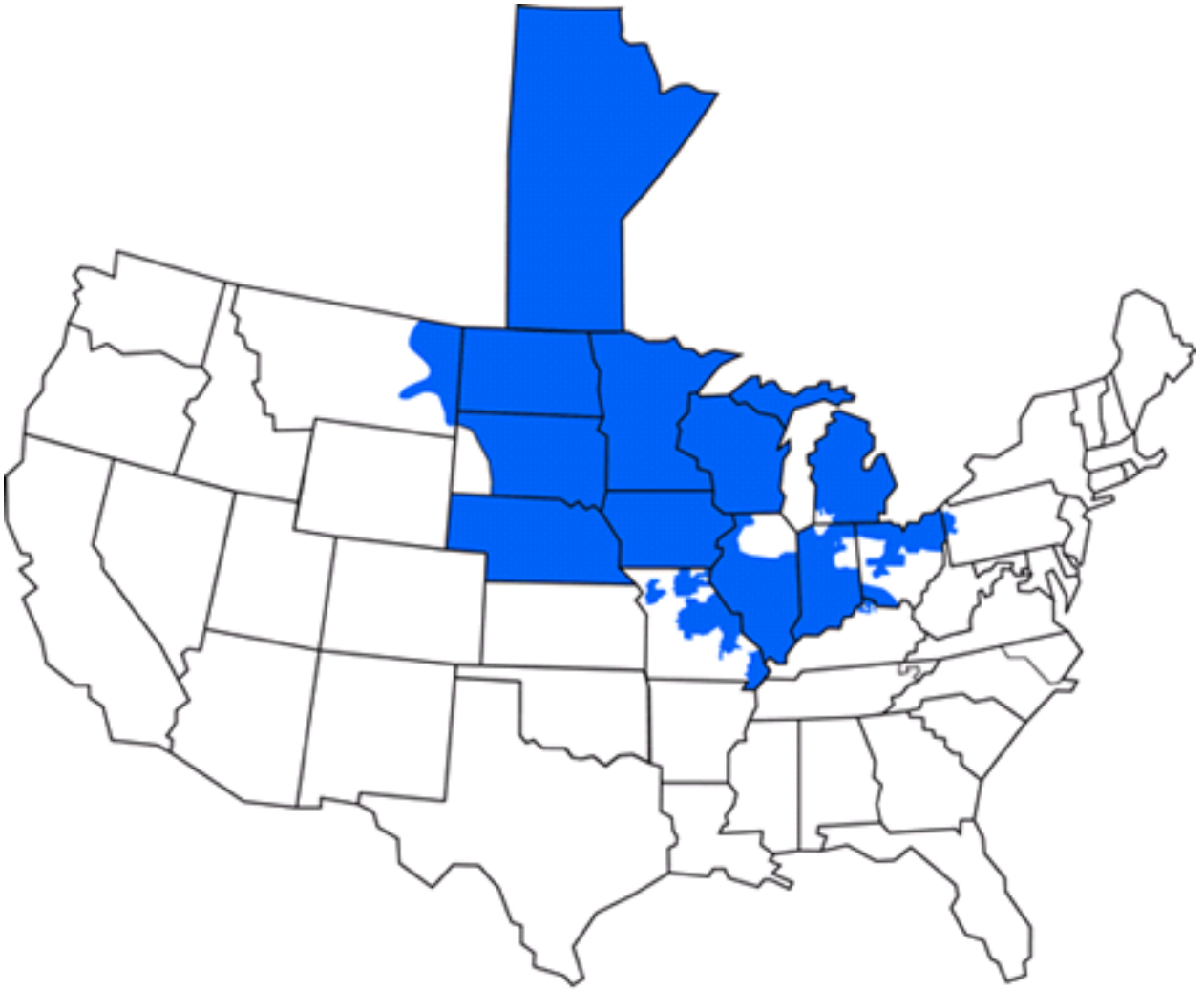
NSP Transmission System

- NSP's transmission assets are located in MN, WI, ND, SD, and MI
  - Under operational control of the Midwest Independent Transmission System Operator, Inc. (MISO)
- Major Utility Interconnections
  - Dairyland Power Cooperative, Great River Energy, Minnesota Power, Manitoba Hydro Electric Board, Otter Tail Power, ITC Midwest, Western Area Power Administration, American Transmission Company LLC and others
- Under Functional control of MISO. NSP System planning subject to MISO Transmission Expansion Plan (MTEP) process

NSP Companies Retail Service Territory



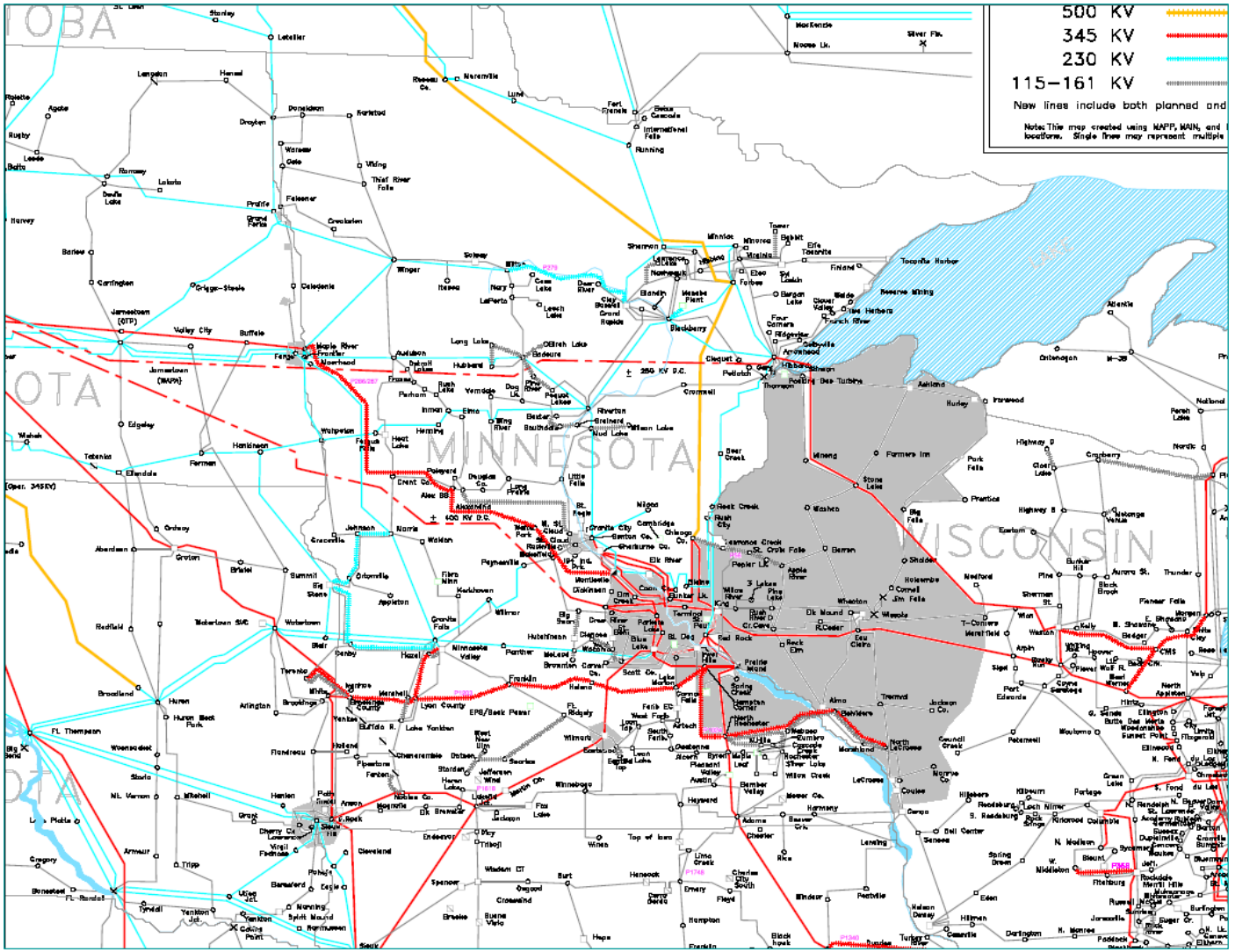
MISO Service Territory



Midwest ISO Regional Reliability Area

Upper Midwest

Transmission Grid



Planning Principles

- Principles
  - Focus on customers and affordability
  - Ensure alignment with policy makers
  - Ensure cost recovery support from regulators
  - Coordinate with local regional utilities
  - Actively participate in regional plan development

NSP System Planning process

- Reliability planning and other studies
- Annual NERC assessments
- Make extensive use of regional planning groups and the MISO MTEP process
  - Participate in the Northern MAPP Sub-Regional Planning Group meetings
  - Issues and proposals submitted to MTEP process
  - Issues and Proposals also aired at the MTO & submittal in the Minnesota Biennial Transmission Planning Report

Generation Interconnection

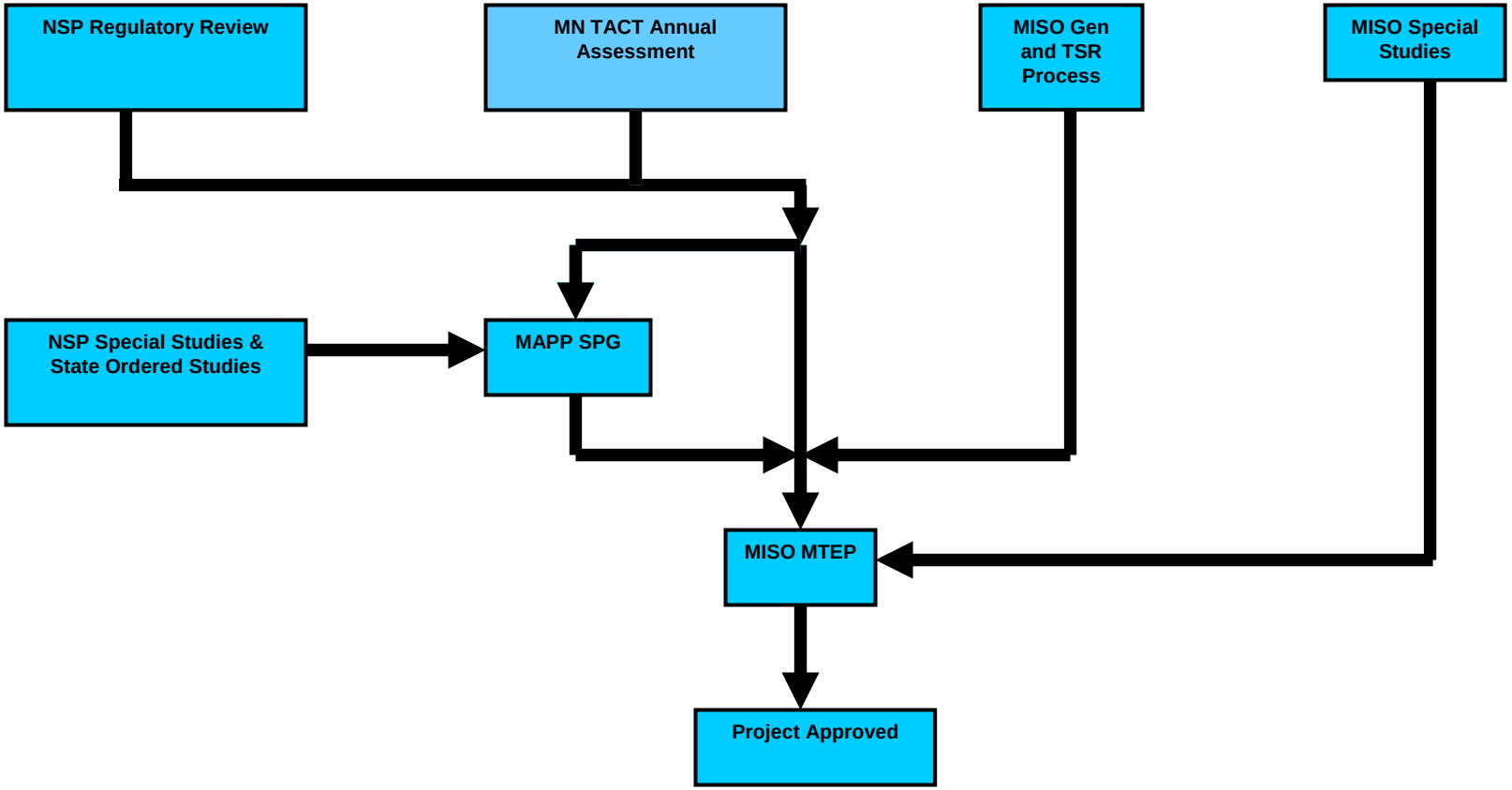
Planning Process

- Planning for Generation Additions Performed by MISO
  - All requests to interconnect with the NSP transmission system must be made with MISO
  - For further information go to:
    - www.midwestiso.org

Regional Planning Process

- **NSP internal reliability annual reviews**
- **MN Transmission Assessment and Compliance Team (MNTACT)**
  - Minnesota joint utility annual NERC assessment
- **MAPP Sub-Regional Planning Group's (SPG)**
  - Coordination of studies and plans
- **MISO Transmission Expansion Plan (MTEP)**
  - MISO annual plan and FERC order 890 compliance
- **MISO Initiated studies**
- **Interconnection-wide planning such as the Eastern Interconnection Planning Collaborative (EIPC)**
- **Special purpose studies**
- **State ordered studies**
  - Renewable Energy Standard (RES)
    - Corridor
    - 2016 RES
  - Distributed Renewable Generation (DRG)
  - MN Biennial Plan

Regional Planning Process



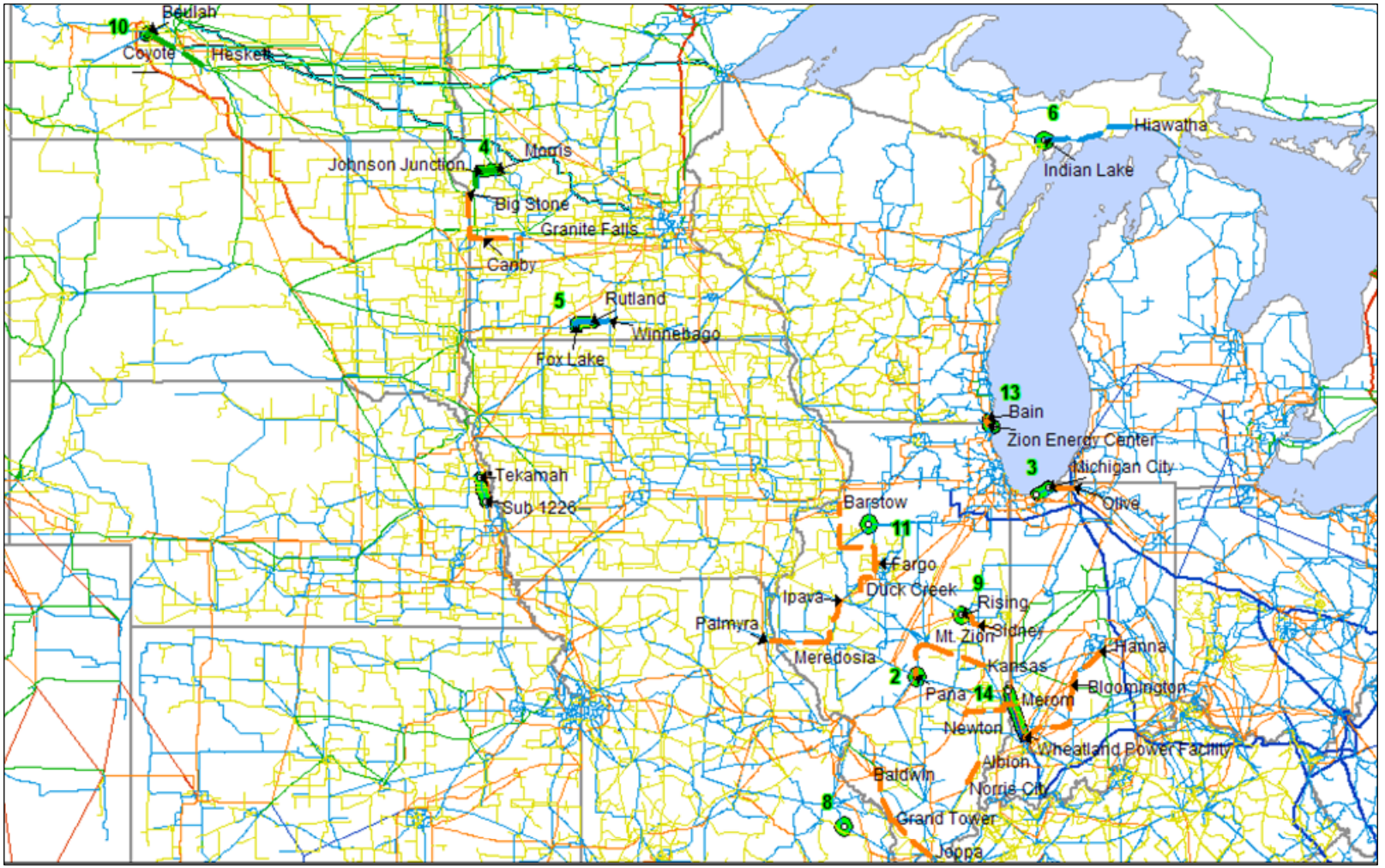
Economic Planning

- Economic planning involves
  - Various resource scenario evaluations
  - Economic impact of market congestion on transmission elements
  - Energy and demand loss evaluation on transmission elements
- Benefits frequently not large enough to justify stand alone transmission investment
- Economic Benefits coupled with other benefits (reliability, local or regional policy, etc) together enter into transmission alternative evaluation

Economic Planning

- NSP reviews studies by others and is actively involved in regional and Sub-Regional economic planning efforts such as:
  - The Department Energy (DOE) national transmission congestion studies
  - MTEP process
  - MAPP SPGs
  - MTO TACT Study Group

MISO Most Congested Flowgates

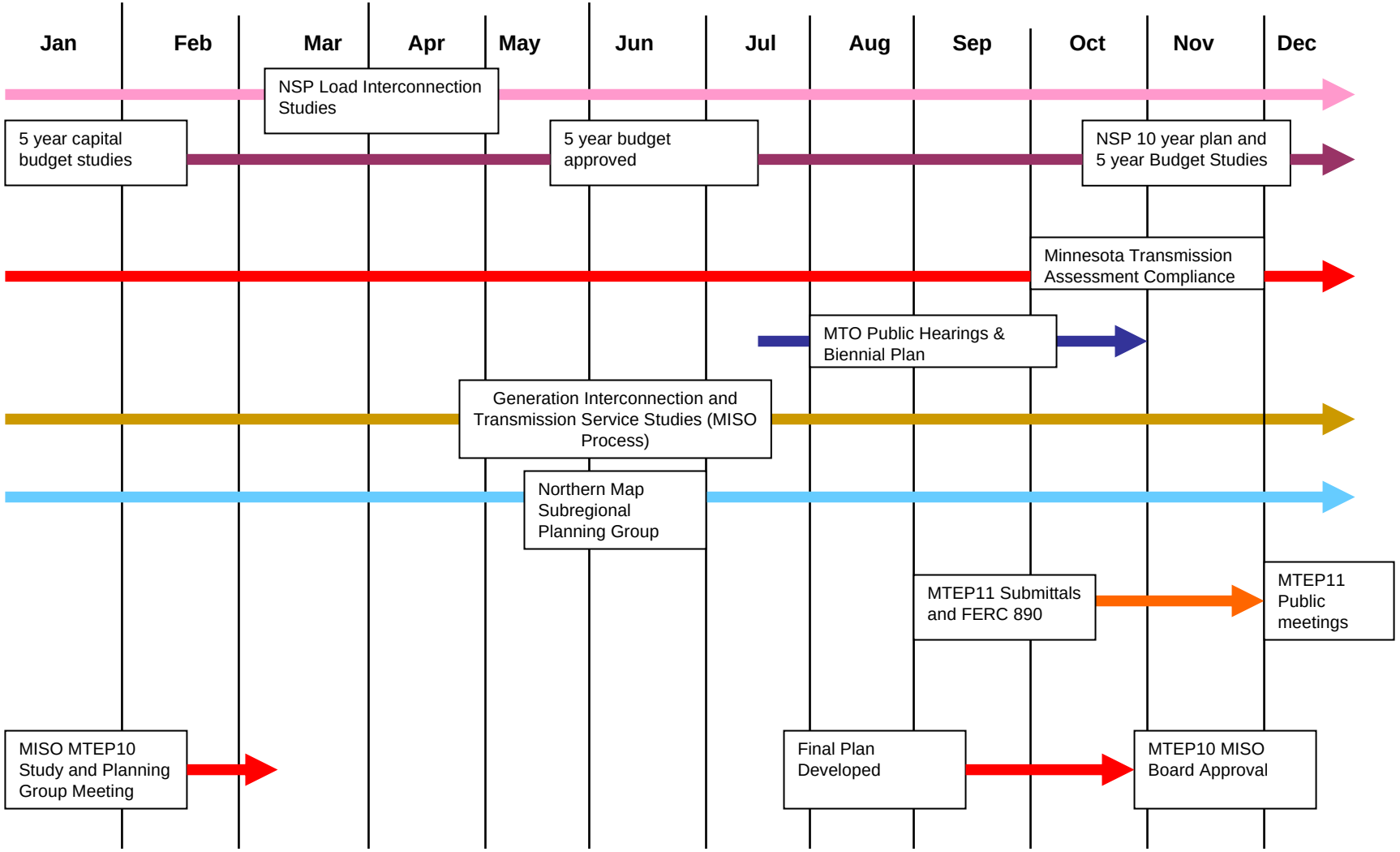


Most MISO transmission congestion is east of Minnesota

Stakeholder input

- MAPP SPG meetings
  - MAPP sends it out on the public exploder email list
  - http://www.mapp.org/
- MISO MTEP process sub-regional meetings
  - MISO posts these SPM meetings on their public website
  - MISO sends out an email to the Transmission Customers list
  - http://www.midwestiso.org/page/Expansion+Planning
- MN Biennial Plan Annual public meetings
  - Local and regional newspaper ad
  - http://www.minnelectrans.com

2010 Planning Process Calendar



Planning Criteria

Steady State Planning Criteria

Limits	System Intact Condition	Post-Contingency Condition
Transmission Line Loading	100% of Rating	110% of rating for single contingency, unless limited by terminal equipment or line clearance
Transformer Loading	100% of Rating	Summer 115% post-contingency if pre-contingency loading is below 90%
Generator Bus Voltage	0.95 to 1.05 per unit	0.95 to 1.05 per unit
Load Bus Voltage	Twin Cities metro 0.92 to 1.05 per unit. Outside TC Metro 0.90 to 1.10 per unit	Twin Cities Metro 0.92 to 1.05 per unit. Outside TC Metro 0.90 to 1.10 per unit.

Planning Criteria

Dynamic Stability Criteria

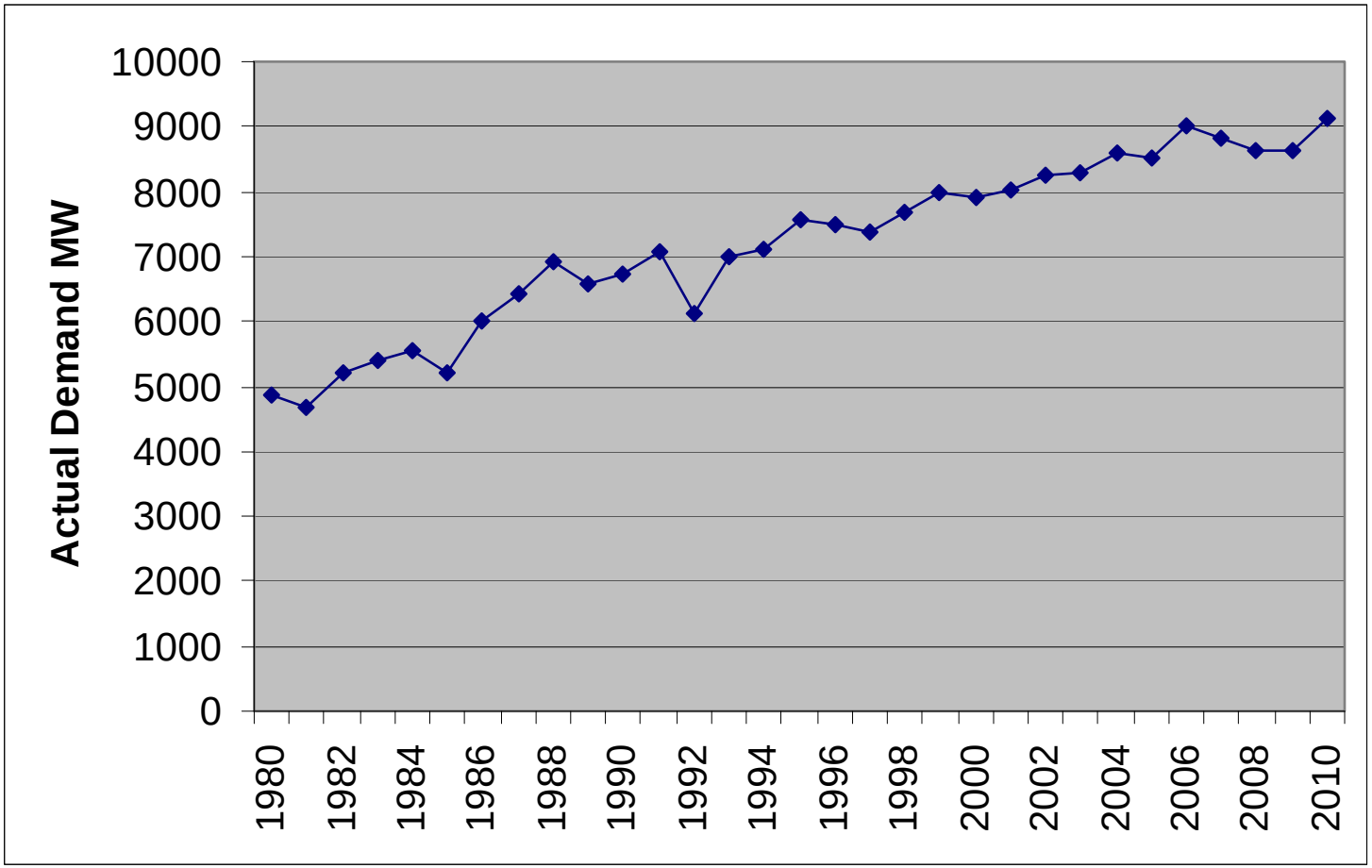
NERC Categories	Transient Voltage Deviation Limits	Rotor Angle Oscillation Damping Ratio Limits
A	Nothing in addition to NERC Requirements	
B	Minimum 0.70 p.u. at any bus	Not to be less than 0.0081633 for disturbances with faults or less than 0.0167660 for line trips.
C	Minimum 0.70 p.u. at any bus	Not to be less than 0.0081633 for disturbances with faults or less than 0.0167660 for line trips.
D	Nothing in addition to NERC Requirements	

Drivers

Transmission Development

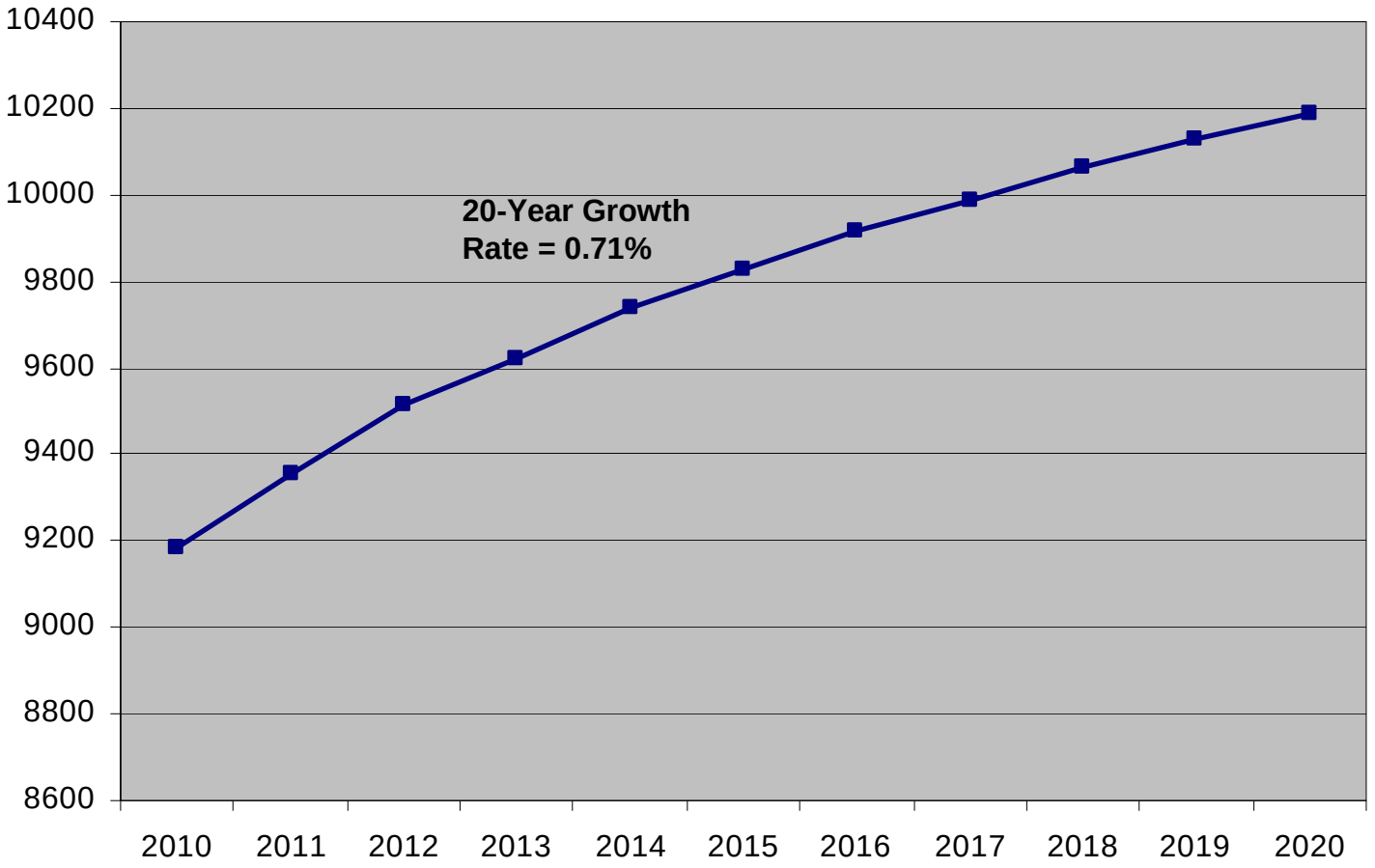
Load growth	▪ Load forecast (9,125 MW in 2010) ▪ Wholesale/retail load serving interconnections ▪ NERC Reliability compliance and planning criteria
State renewable portfolio standards	▪ MN RES 30 % renewables by 2020 ▪ Wisc RES 10% renewables by 2015 ▪ ND RES 10% renewables by 2015 ▪ SD RES 10% renewables by 2015
Regional and National Renewable Policy	▪ Western MN, Eastern ND & SD major wind resources ▪ National Energy policy • Potential national Renewable Energy Standard • Carbon Emissions Reduction (Cap and Trade?) • Intermittent renewable resource reliability and operations criteria

Historic Load Growth (NSP Native)



Drivers

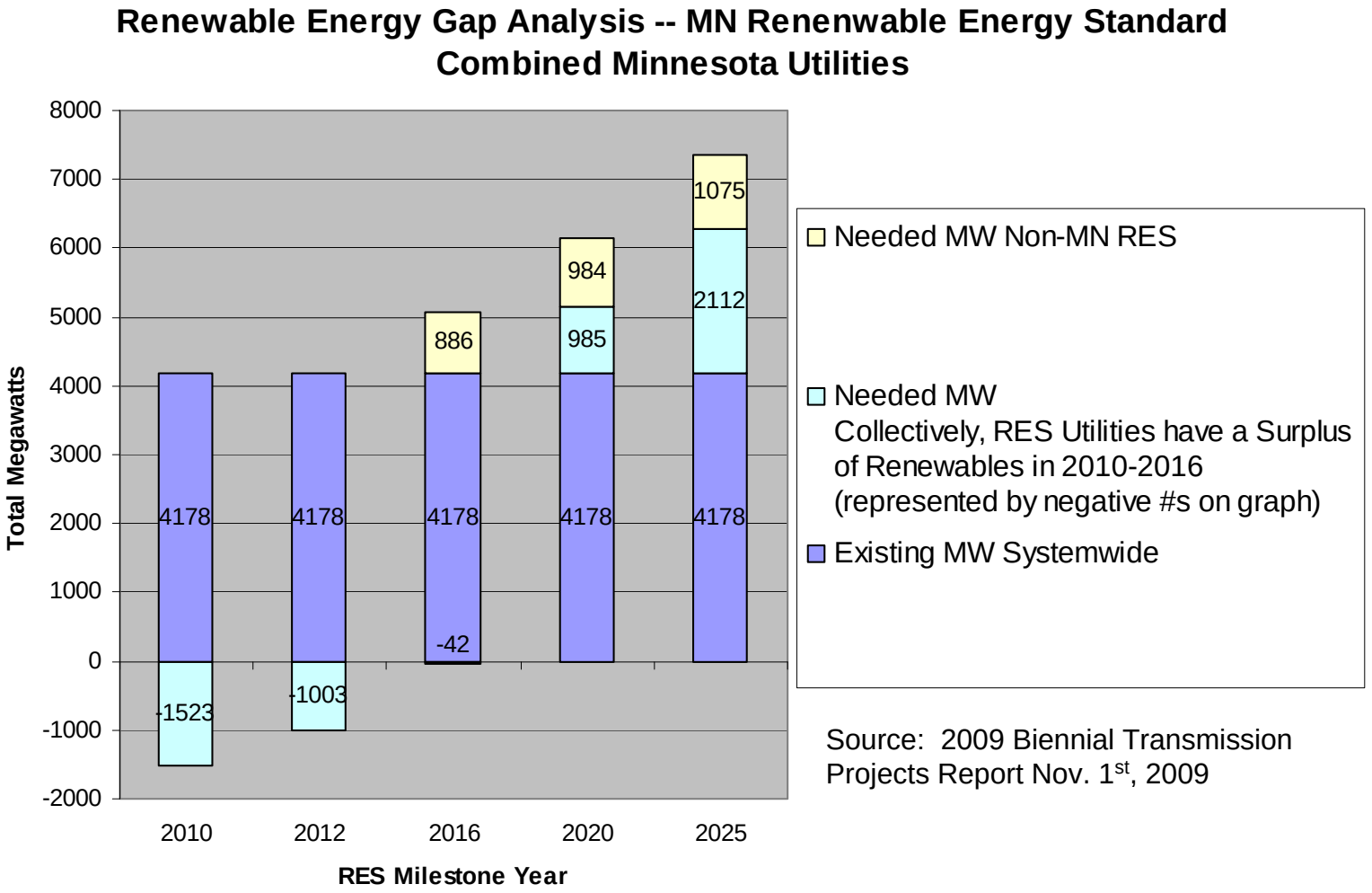
Low but continuing load growth (NSP Native)



*Forecast October 2010

Driver

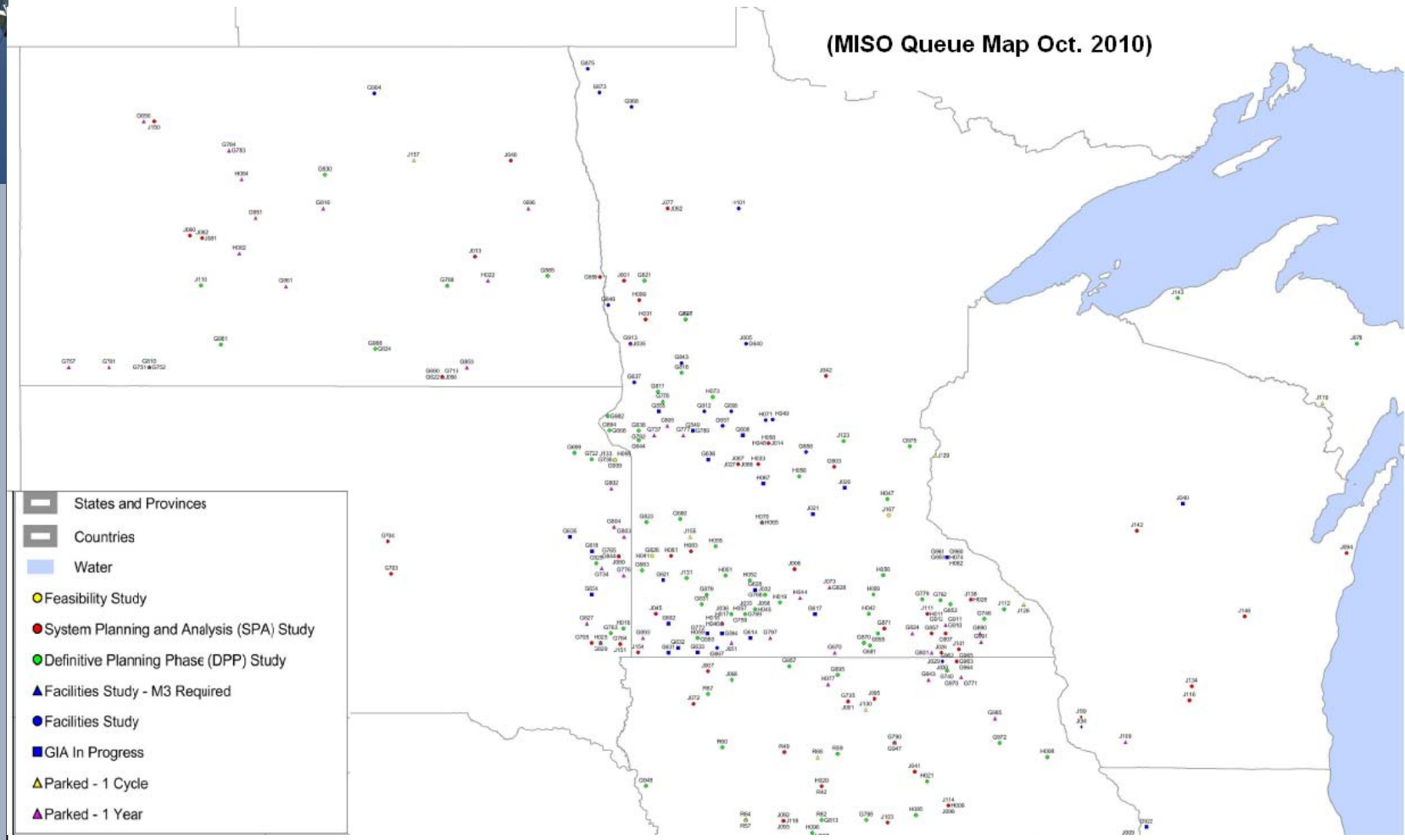
State Renewable Generation Policy



Source: 2009 Biennial Transmission Projects Report Nov. 1st, 2009

Driver

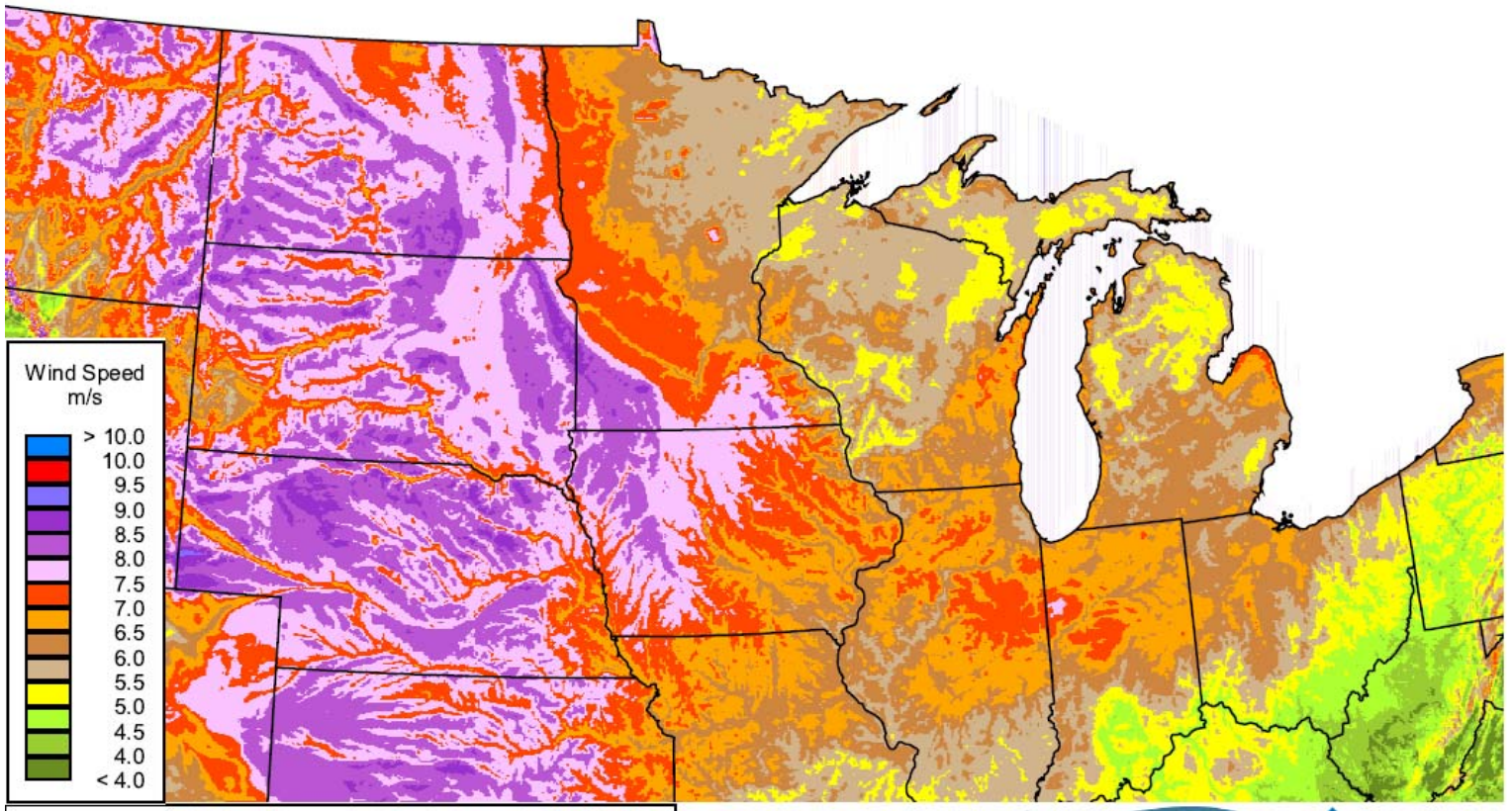
Generation Additions



Driver

National Renewable Policy

Midwest wind for national RES?



Source: Wind resource estimates developed by AWS Truewind, LLC for windNavigator® Web: http://navigator.awstruewind.com | www.awstruewind.com. Spatial resolution of wind resource data: 2.5 km. Projection: Albers Equal Area WGS84.

AWS Truewind

NREL National Renewable Energy Laboratory
Innovation for Our Energy Future

28-JAN-2010 4.1.1

NSP System Sub-regional Plan

CAPX2020

Group 1 Projects

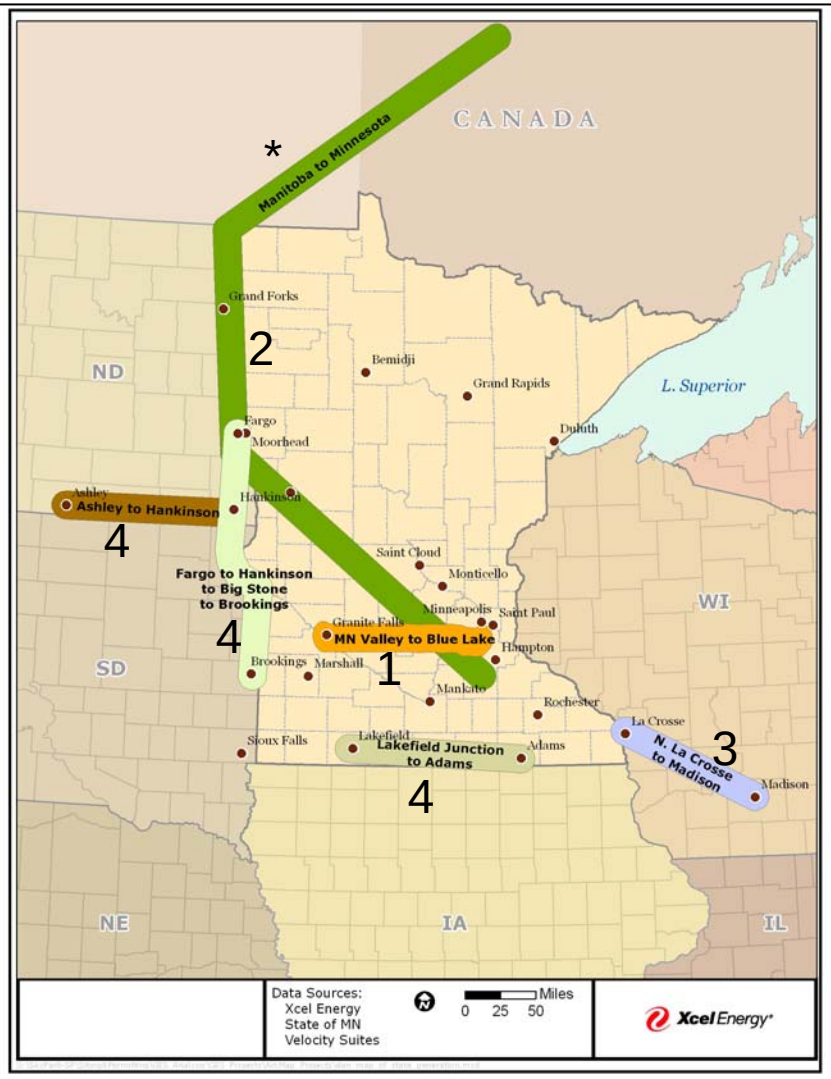
Nearly 700 miles and $1.7 billion ▪ Upsizing adds about $200 million	
Fargo-St. Cloud-Monticello	250-miles, 345-kV
Brookings County-Hampton	240-miles, 345-kV
Hampton-Rochester-La Crosse	150-miles, 345-kV
Bemidji-Grand Rapids	70-miles, 230-kV

- Alleviates emerging community service reliability concerns around the state
- Critical foundation for future transmission and generation
- Provide needed transmission capacity to support new generation outlet
- In-service dates from 2011-2015

- **CAPX 2020 Group 1 projects resulted from Vision plan**

Post CapX 2020

Potential Projects



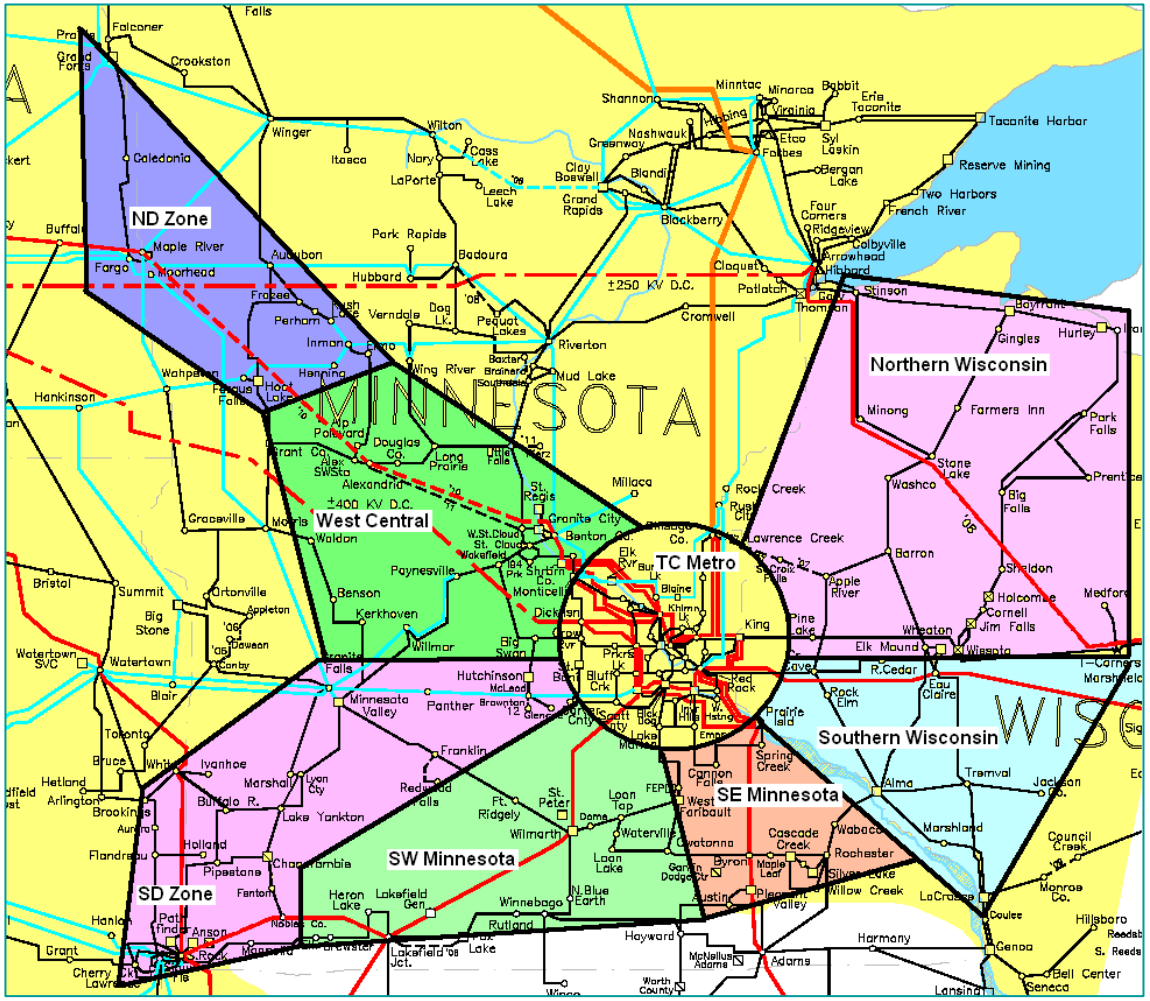
1. **Corridor (Granite Falls-Twin Cities 345 kV) Project**
   - Next likely development
   - Increase Western MN- MISO market transfer 1000MW
   - Support wind generation development
2. **Manitoba- Minnesota 500 kV**
   - Increase MH to US transfer 1100 MW
   - MISO Manitoba Hydro Group TSR Study
3. **La Crosse-Madison 345 kV**
   - Multiple purpose line
   - Increase Western MN- MISO market transfer 2000MW
4. **Other potential projects further support wind generation development**

NSP CORE

10-Year Transmission Plan

5-Year Expansion Plan (2010-2014)

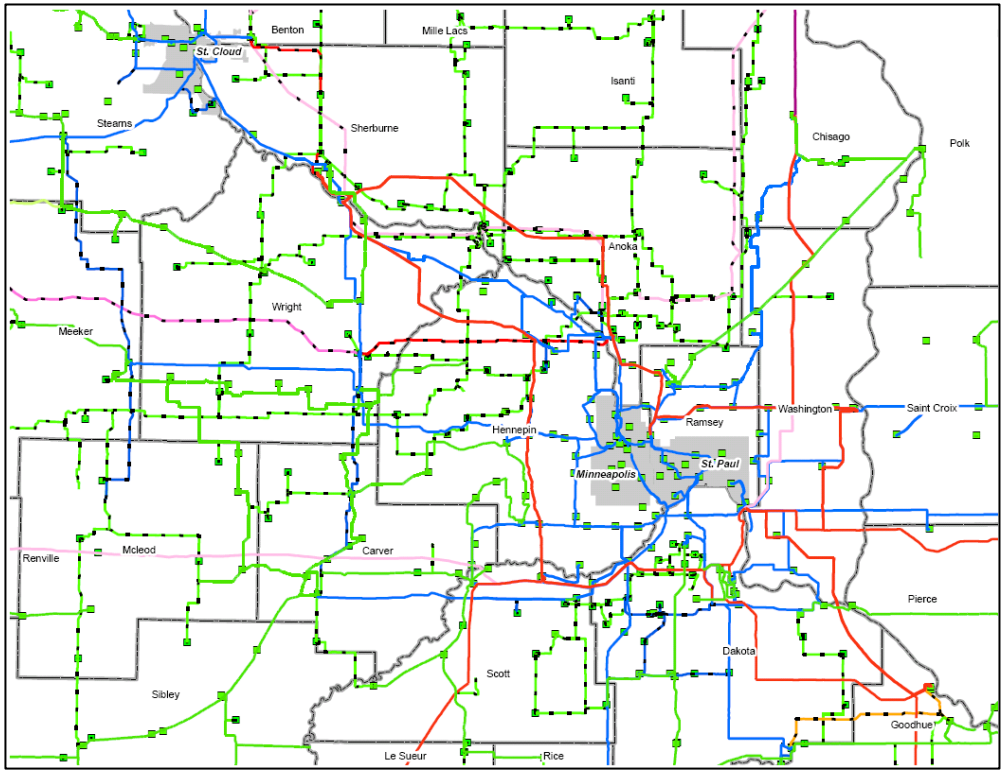
Planning Zones



Zone 1	**Twin Cities Metro Area**
Zone 2	**Southeast Minnesota**
Zone 3	**St Cloud and West Central Minnesota**
Zone 4	**South Dakota / Sioux Falls**
Zone 5	**Northern Wisconsin**
Zone 6	**Southern Wisconsin**
Zone 7	**North Dakota**
Zone 8	**Minnesota Valley / SW Minnesota**

Proposed Transmission Projects

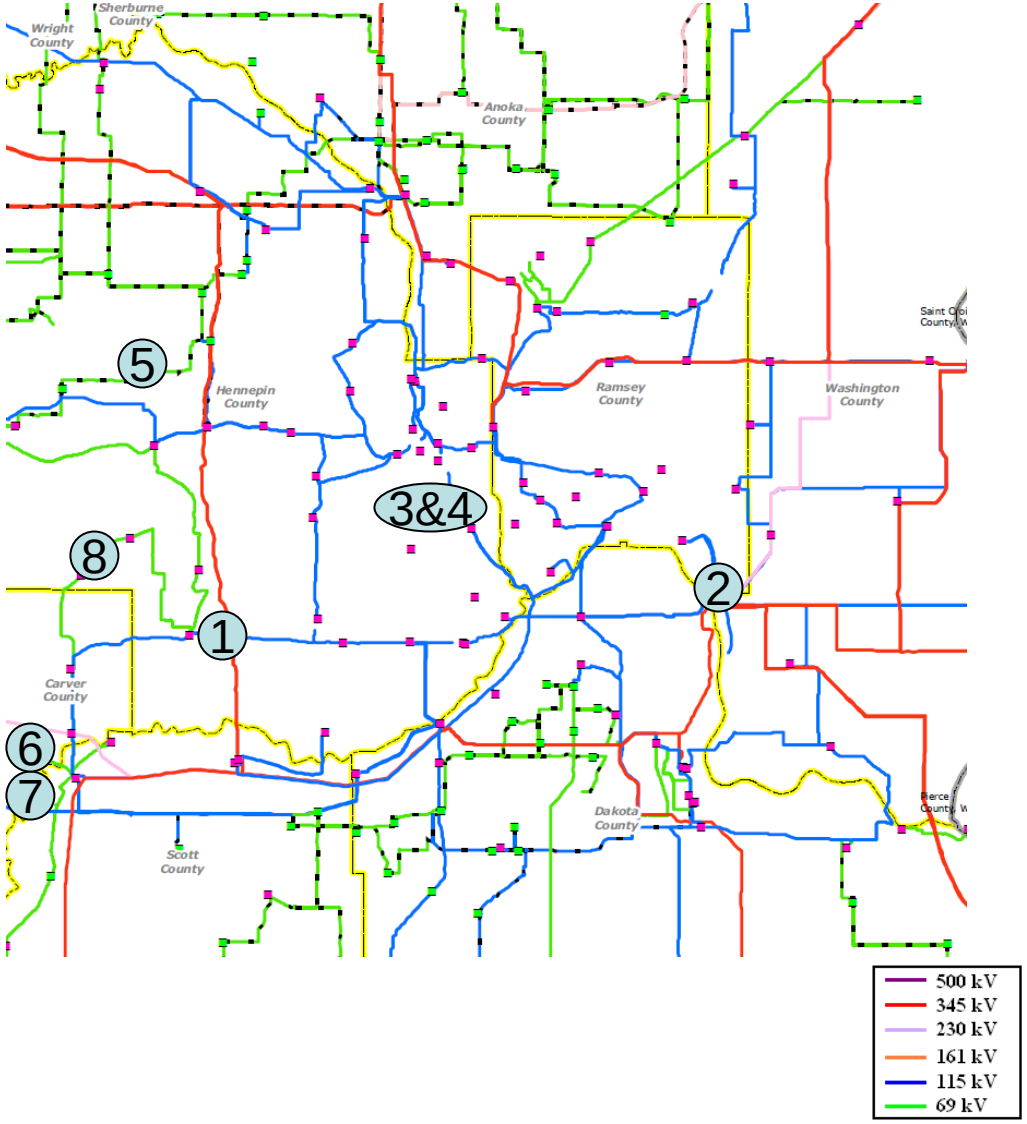
Zone 1: Twin Cites Metro Area



- **Twin Cities metro made up of Minneapolis/St. Paul and surrounding suburbs**
- **Max Generation: 3518 MW**
- **Peak Load: 5388 MW (60% of NSP System load)**
- **CAPX 2020 Brookings 345 kV line begins development of an outer 345 kv transmission ring of the metro area.**
- **Issues**
  - 345 kV transformer capacity maxed out
  - Impact of reduced 115 kV generation due to high wind generation conditions
  - Inner city/suburbs require new distribution substations with associated transmission
  - Expansion of metro growth outside the US 694/494 freeway loop

Proposed Transmission Projects

Zone 1: Twin Cites Metro Area (2010-2014)

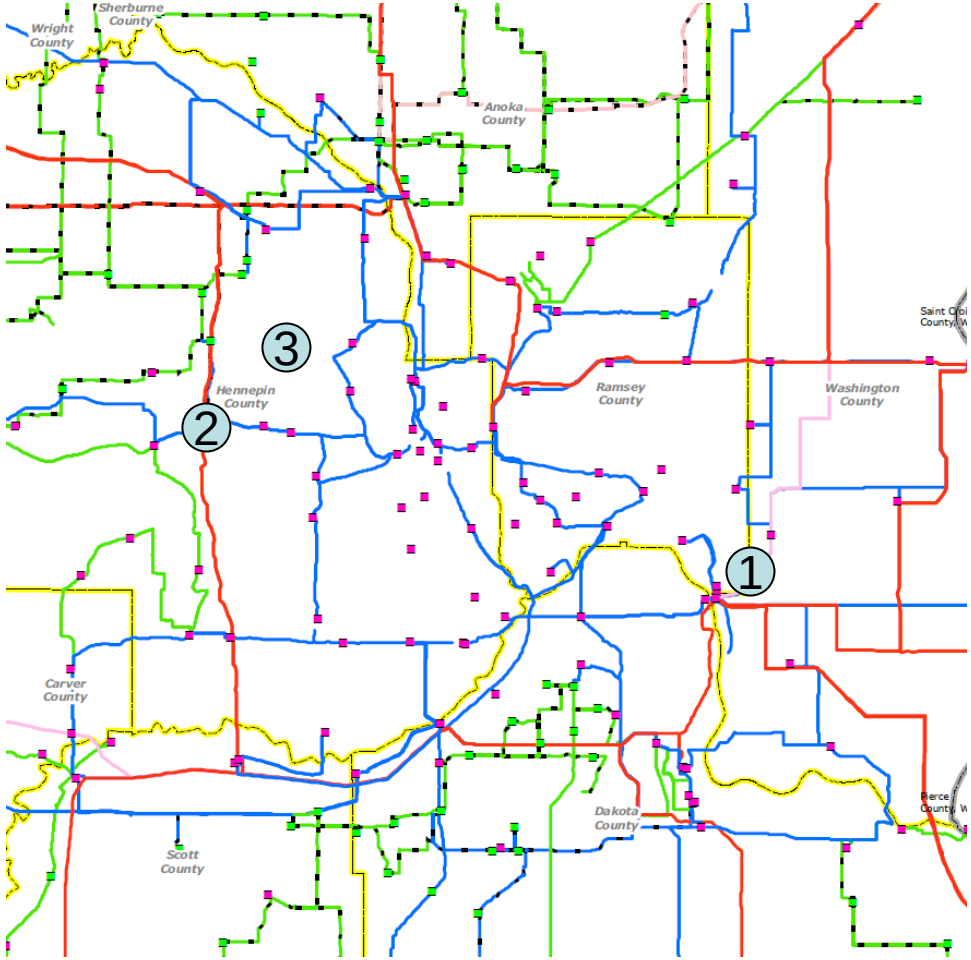


#	Project	Comments	ISD	Drivers
1	Eden Prairie 345/115 kV transformer	Replace existing 448 MVA transformers with two new 672 MVA transformers	TBD	Reliability
2	Upgrade Red Rock transformers	Upgrade Red Rock 115/345 kV transformers to 672 MVA	TBD	Reliability
3	New 115kV substations	Hiawatha and Midtown new 115kV Substations	2011	Distribution
4	Hiawatha – Midtown 115kV	New double circuit 115kV line from Hiawatha to Midtown	2011	Distribution
5	Hollydale Distribution Interconnection	Upgrade distribution substation to 115 kV and increase loading	2013	Distribution
6	Scott Co.-Augusta –West Waconia conversion	Convert the existing 69 kV line along with the distribution substations to 115 kV	2013	Reliability
7	Glencoe – West Waconia conversion	Convert the 69 kV line between Glencoe and West Waconia to 115 kV	2013	Reliability
8	Scott County-Westgate conversion	Convert the 69 kV line between Westgate – Scott County to 115 kV along with Excelsior and Deephaven substations	2014	Reliability

Note: Project scope and timing subject to change

Potential Transmission Projects

Zone 1: Twin Cites Metro Area (2015-2019)

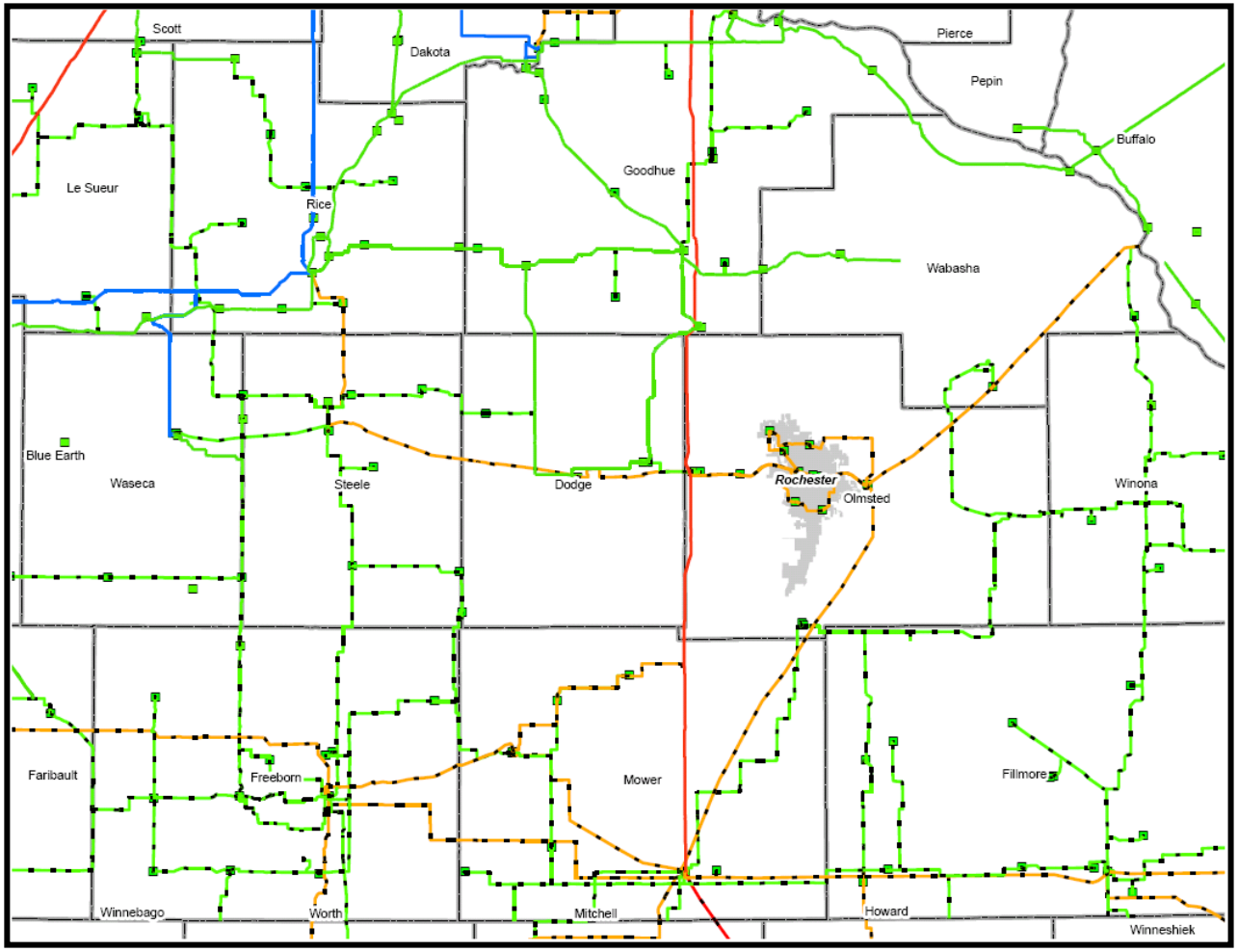


#	Project	Comments	ISD	Drivers
1	Red Rock – Afton 115 kV	Rebuild existing Red Rock – Afton 115kV line to 795 ACSS		Reliability
2	Parkers Lake 345/115 kV transformer	Replace existing 448 MVA transformers with two new 672 MVA transformers		Reliability
3	Meadow Lake Distribution Interconnection	New 115 kV distribution substation and line	2015	Distribution

500 kV
345 kV
230 kV
161 kV
115 kV
69 kV

Proposed Transmission Projects

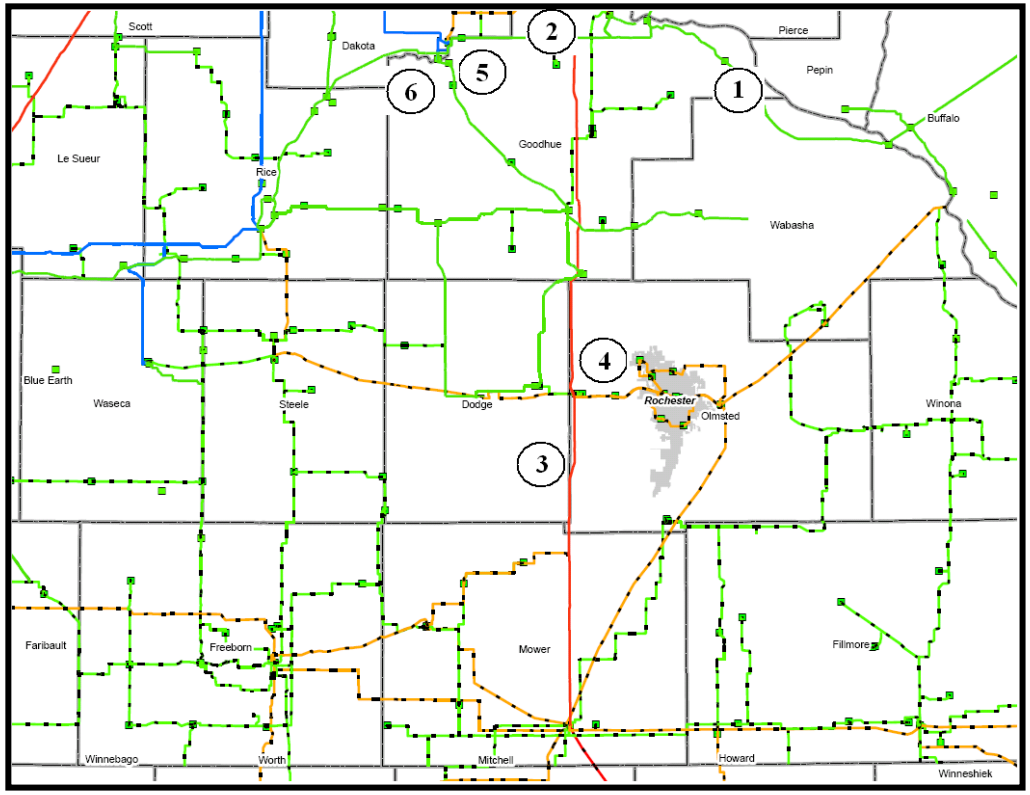
Zone 2: South East Minnesota



- **Rochester is the major load center. RPU owned.**
- **Increased interest in renewable generation in this area.**
- **Max Generation: 2422 MW**
- **Except in the vicinity of Rochester this area is primarily rural with minimal load growth**
- **CAPX 2020 La Crosse 345 kV line will add substantial**
- **capability to serve Rochester**
- **Issues**
  - Wind generation potential
  - Aging 69 kV infrastructure

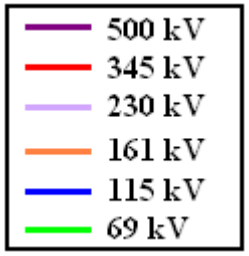
Proposed Transmission Projects

Zone 2: South East Minnesota (2010-2014)



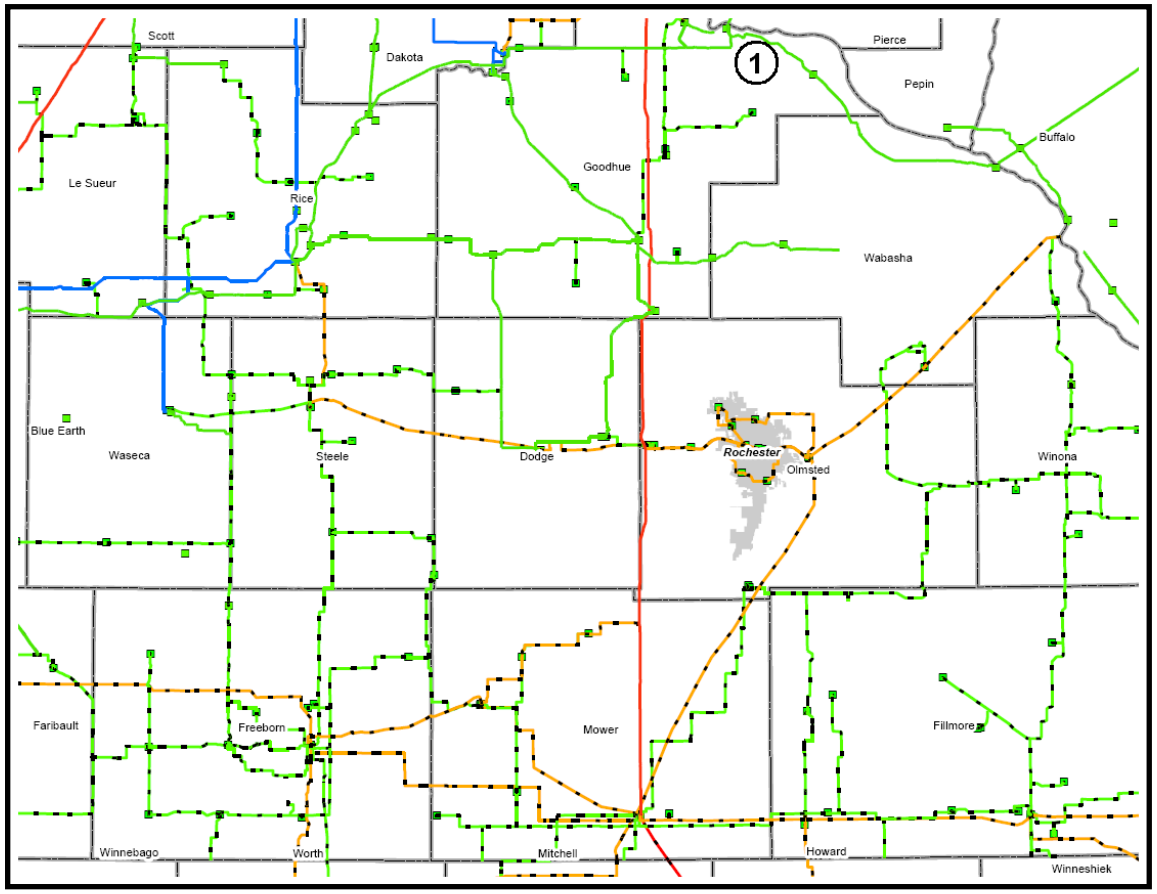
Note: Project scope and timing subject to change

#	Project	Comments	ISD	Drivers
1	Lake City – Wabasha 69kV line	Rebuild existing 69kV line from Lake City to Wabasha	2011	Reliability
2	Prescott Cap bank	Add a new 10 MVAR capacitor bank	2014	Reliability
3	Pleasant Valley – Byron 161kV	New 161kV line from Pleasant Valley – Byron (RIGO)	2011	Generation Outlet
4	2nd 161 kV line Byron-West Side Energy Park (SMMPA to build)	Complete the double circuit 161 kV from Byron-Maple Leaf-Cascade Creek	2011	Generation Outlet
5	Colvill transformer	Colvill 112 MVA 115/69kV transformer, including new breakers	2011	Generation Outlet
6	Colvill – Byllesby 69kV	Colvill to Byllesby 69kV line 477 ACSR	2011	Generation Outlet



Potential Transmission Projects

Zone 2: South East Minnesota (2015-2019)



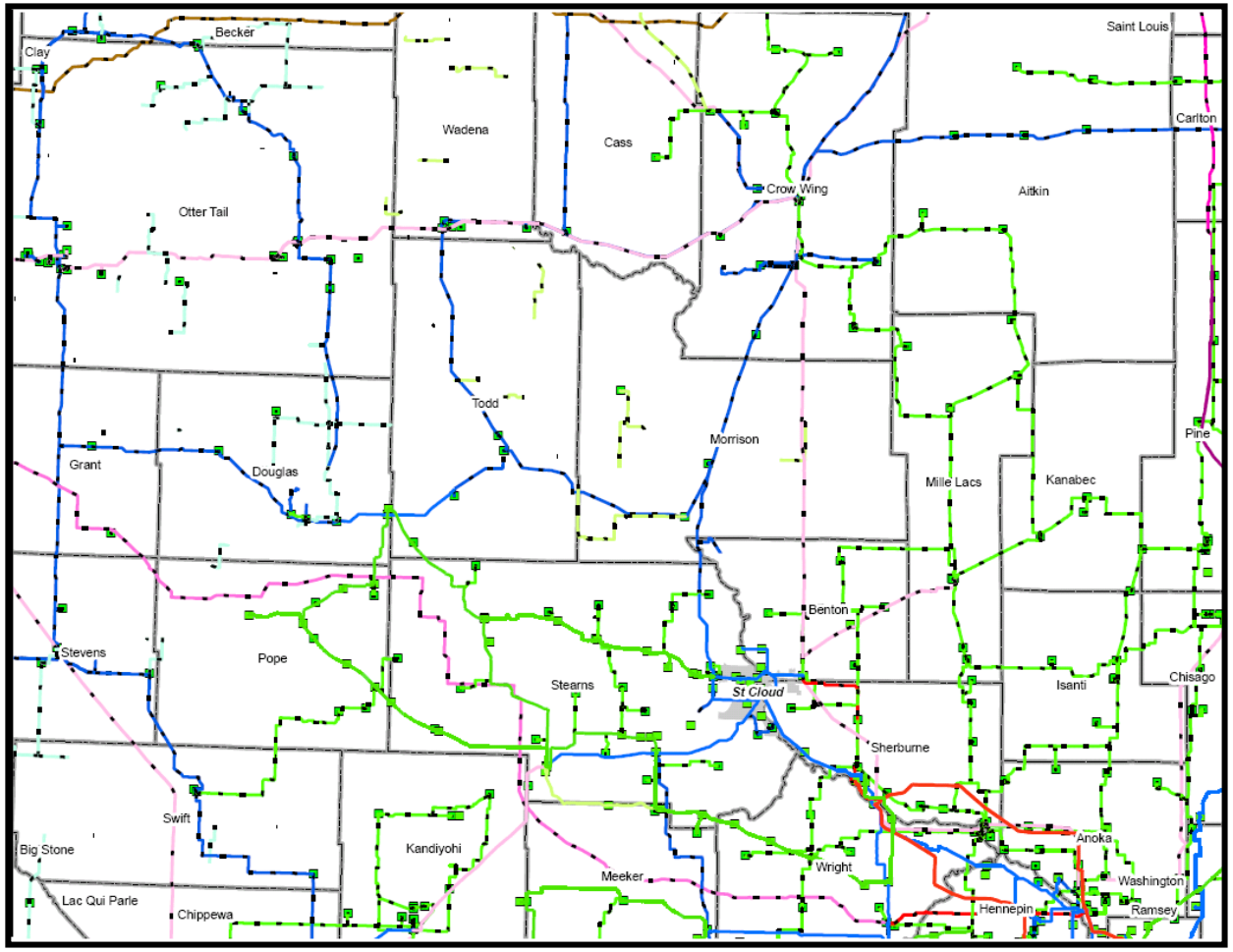
#	Project	Comments	ISD	Drivers
1	Spring Creek – Lake City 161 kV line	Build 161 kV line along existing 69kV line corridor (double circuit).	2015-2019	Reliability

500 kV
345 kV
230 kV
161 kV
115 kV
69 kV

Note: Project scope and timing subject to change

Proposed Transmission Projects

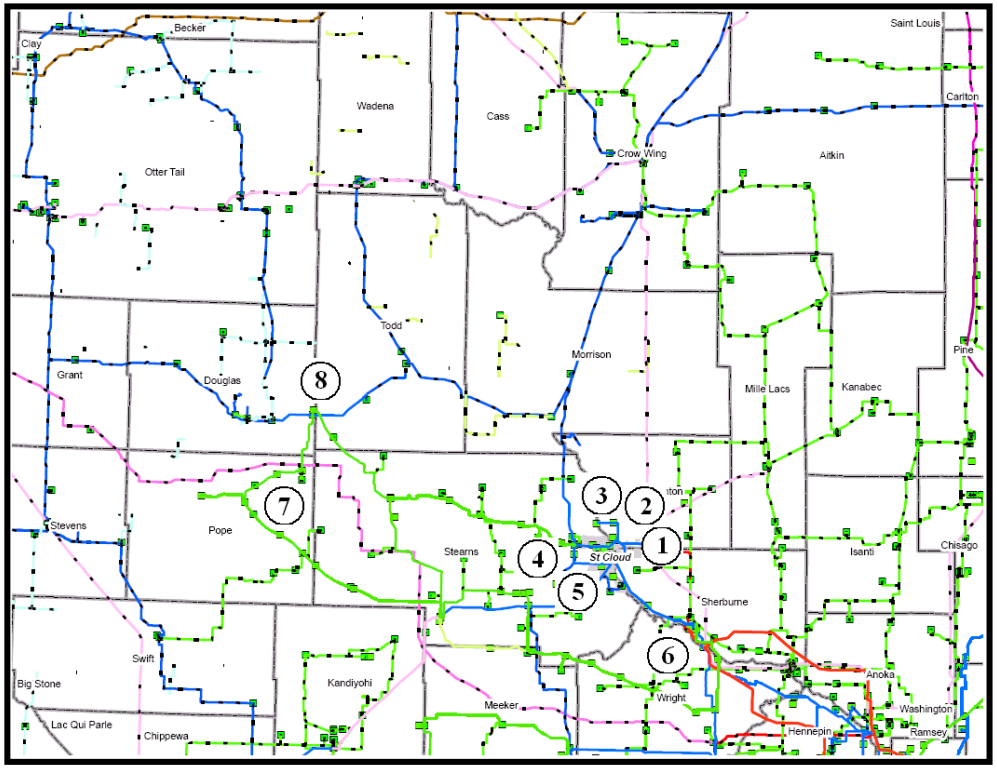
Zone 3: West Central Area



- **St. Cloud is the largest load center in the area.**
- **CAPX 2020 Fargo-Monticello line will help support the area.**
- **Max Generation: 2976 MW**
- **CAPX 2020 Fargo line will provide the bulk power transmission anchor for the reliability of the whole planning zone.**
- **Issues**
  - St. Cloud transmission maxed out
  - Minimal growth in the west
  - Small wind development in the west

Proposed Transmission Projects

Zone 3: West Central Area (2010-2014)



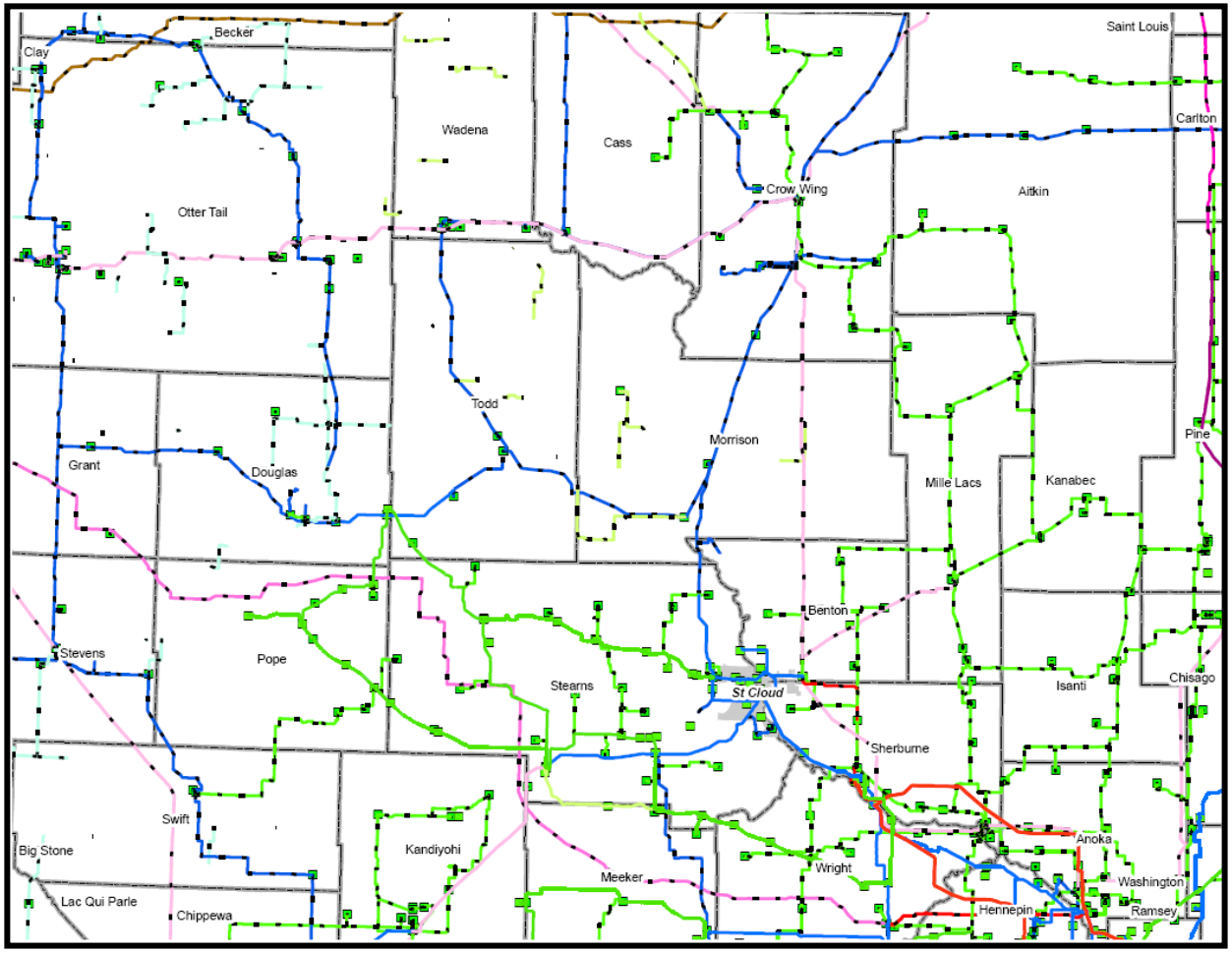
500 kV
345 kV
230 kV
161 kV
115 kV
69 kV

Note: Project scope and timing subject to change

#	Project	Comments	ISD	Drivers
1	Benton Co. – Mayhew Lake 115kV	Re-Terminate one of the Benton – Granite City circuit into Mayhew Lake substation, by building 4 miles of new 115 kV line.	2012	Reliability
2	St. Cloud – Granite City 115kV	Eliminate the 3 terminal line between Granite City, Benton County and St. Cloud	2012	Reliability
4	Sauk River – West St Cloud 115kV	Upgrade Sauk River to West St Cloud 115kV line to 795 ACSS	2011	Reliability
5	Maple Lake – Watkins 69kV	Rebuild Maple Lake to Watkins 69kV line to 477 ACSR	2012	Reliability
6	Sherco Data Center	Add new data center to the Sherco Substation	TBD	Load
7	Grove Lake – Glenwood 69kV	Rebuild existing 69 kV line to 477 ACSR	2011	Reliability
8	Paynesville – Belgrade 69kV	Rebuild existing 69 kV line to 477 ACSR	2015	Reliability
9	Douglas County 69 kV work	2nd 115/69 kV transformer at Douglas County	2011	Reliability

Potential Transmission Projects

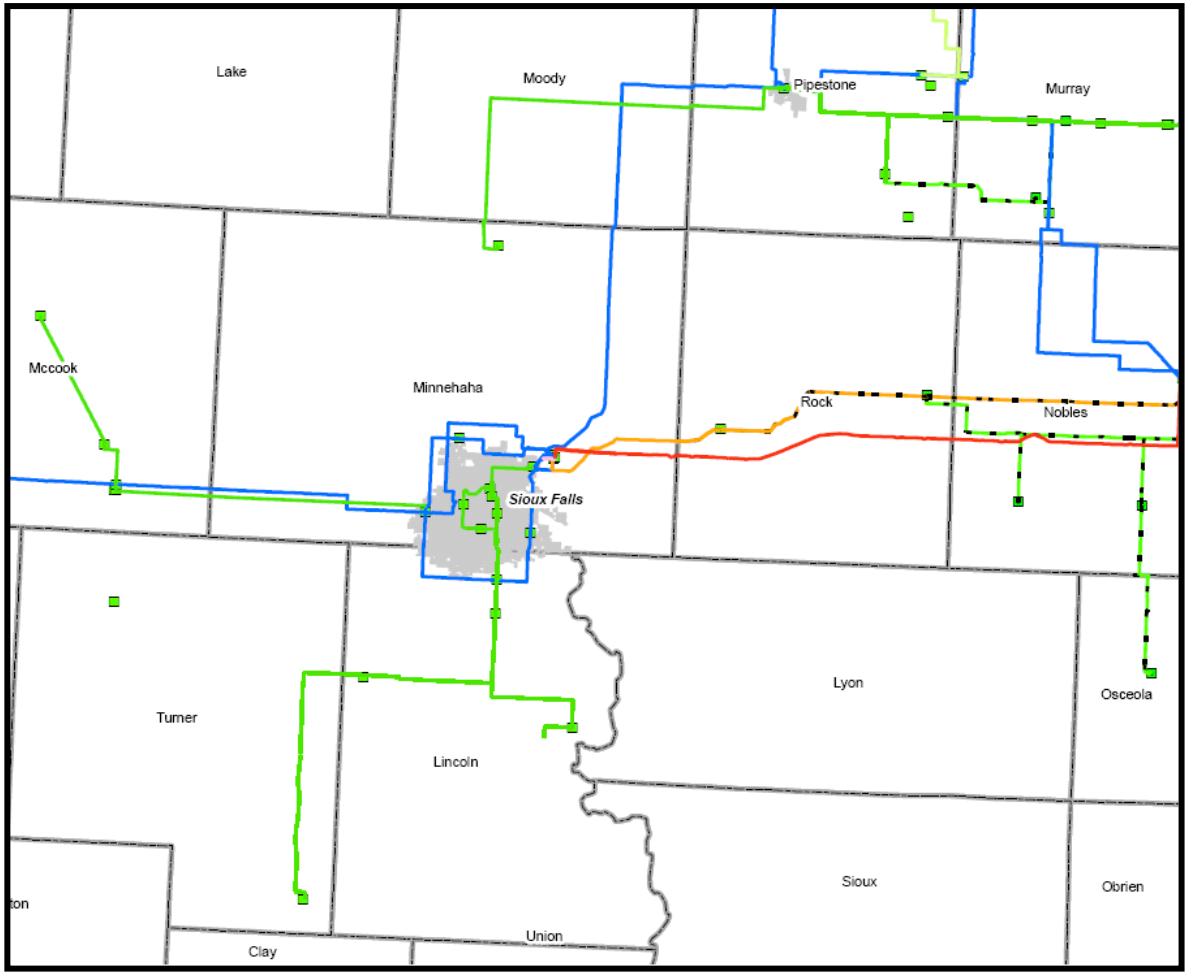
Zone 3: West Central Area (2015-2019)



- **Possible 69 kV condition upgrades outside of the St. Cloud area.**
- **Possible wind development could drive upgrades in the west.**

Proposed Transmission Projects

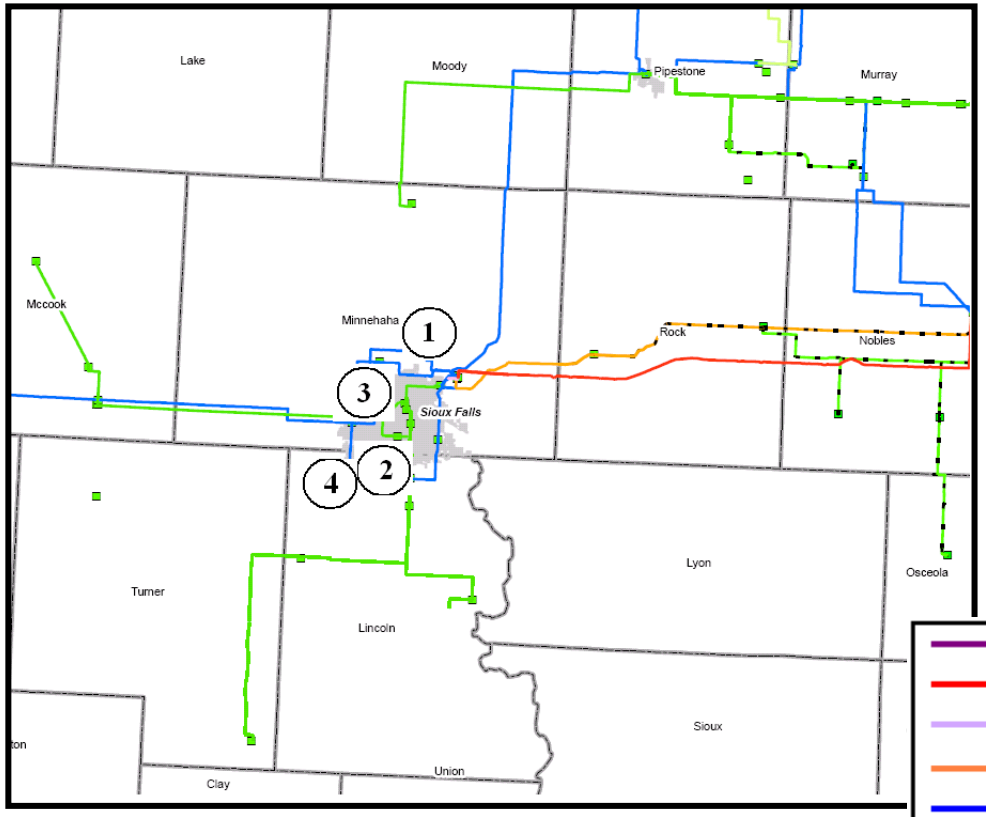
Zone 4: Sioux Falls Area



- **Sioux Falls is the largest load center in this area.**
- **Close proximity to the Buffalo Ridge area.**
- **Wind generation is heavily located around this area.**
- **Issues**
  - Expansion of medical campus planned in central and west Sioux Falls
  - Large amounts of wind generation potential west of the city.
  - At western edge of NSP System/MISO

Proposed Transmission Projects

Zone 4: Sioux Falls Area (2010-2014)

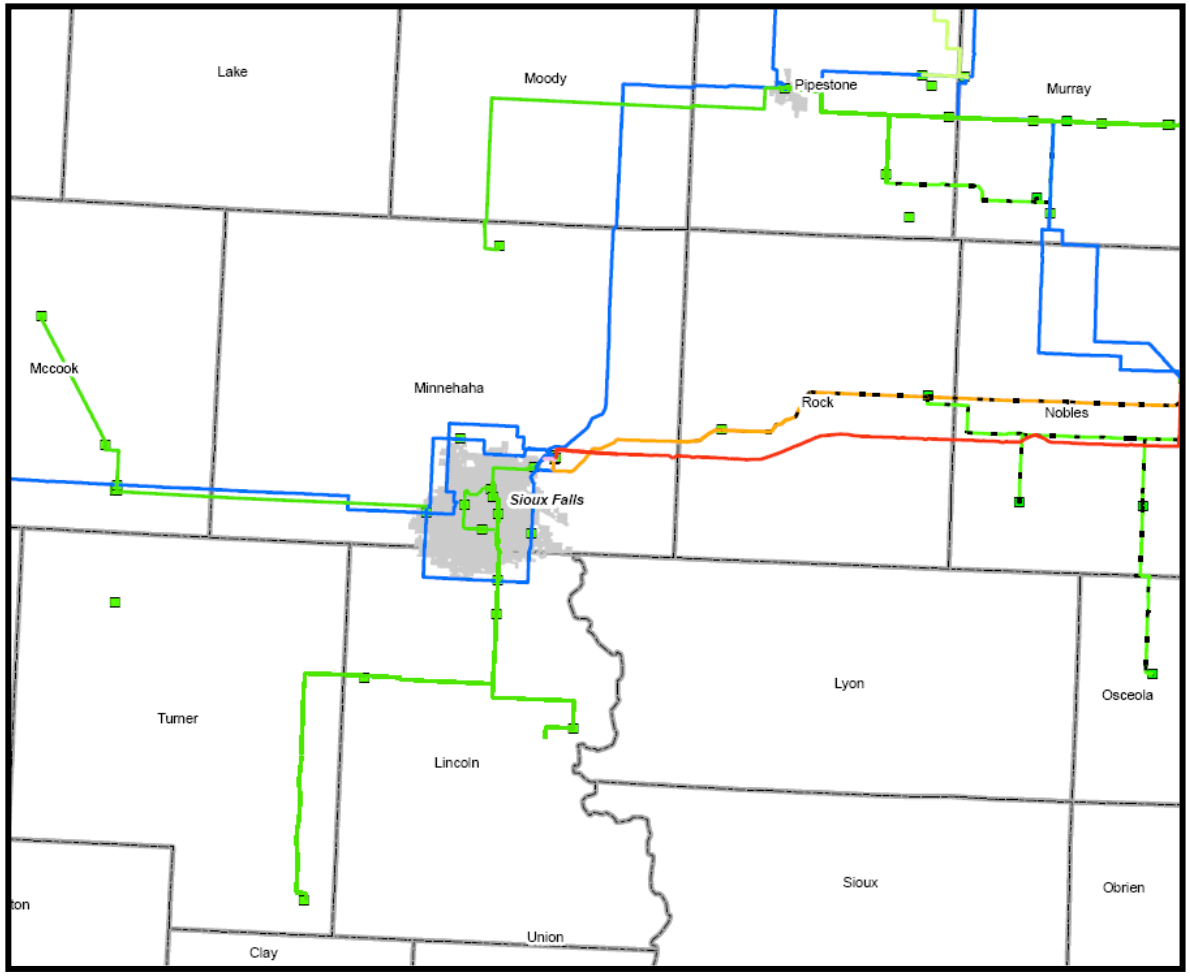


#	Project	Comments	ISD	Drivers
1	New 115 kV Lawrence substation	Convert existing Lawrence 115/69/34.5 kV substation to 115/34.5 kV, breaker and a half configuration	2014	Reliability
2	Sioux Falls new 115 kV substation	Relocate existing Sioux Falls substation and convert from 69/13.8 kV to 115/13.8 kV	2014	Reliability
3	West Sioux Falls – Sioux Falls – Lawrence 69 kV Line Conversion to 115 kV	Convert existing West Sioux Falls – Sioux Falls – Lawrence 69 kV line to 115 kV (795 ACSS) and minimal substation termination work at West Sioux Falls	2014	Reliability
4	Louise Substation	Add new 115 kV substation on south side of Sioux Falls	2011	Distribution

Note: Project scope and timing subject to change

Proposed Transmission Projects

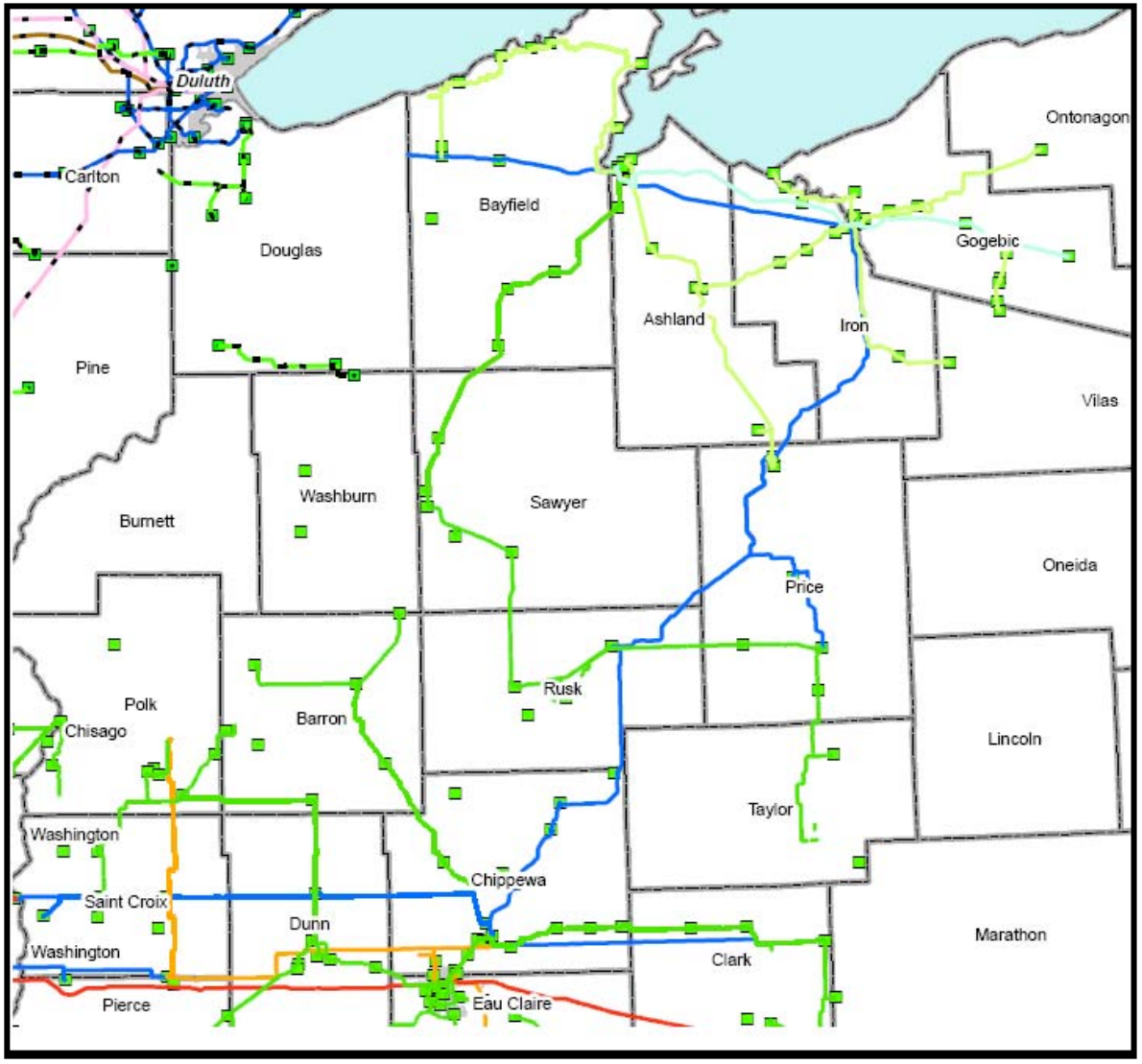
Zone 4: Sioux Falls Area (2015-2019)



- **Potential need for bulk supply source on the west side of the city of Sioux Falls sometime after 2019**
- **Growing load around the 115 kV loop**
- **Wind development may accelerate need for additional bulk supply sources around Sioux Falls in the future**

Proposed Transmission Projects

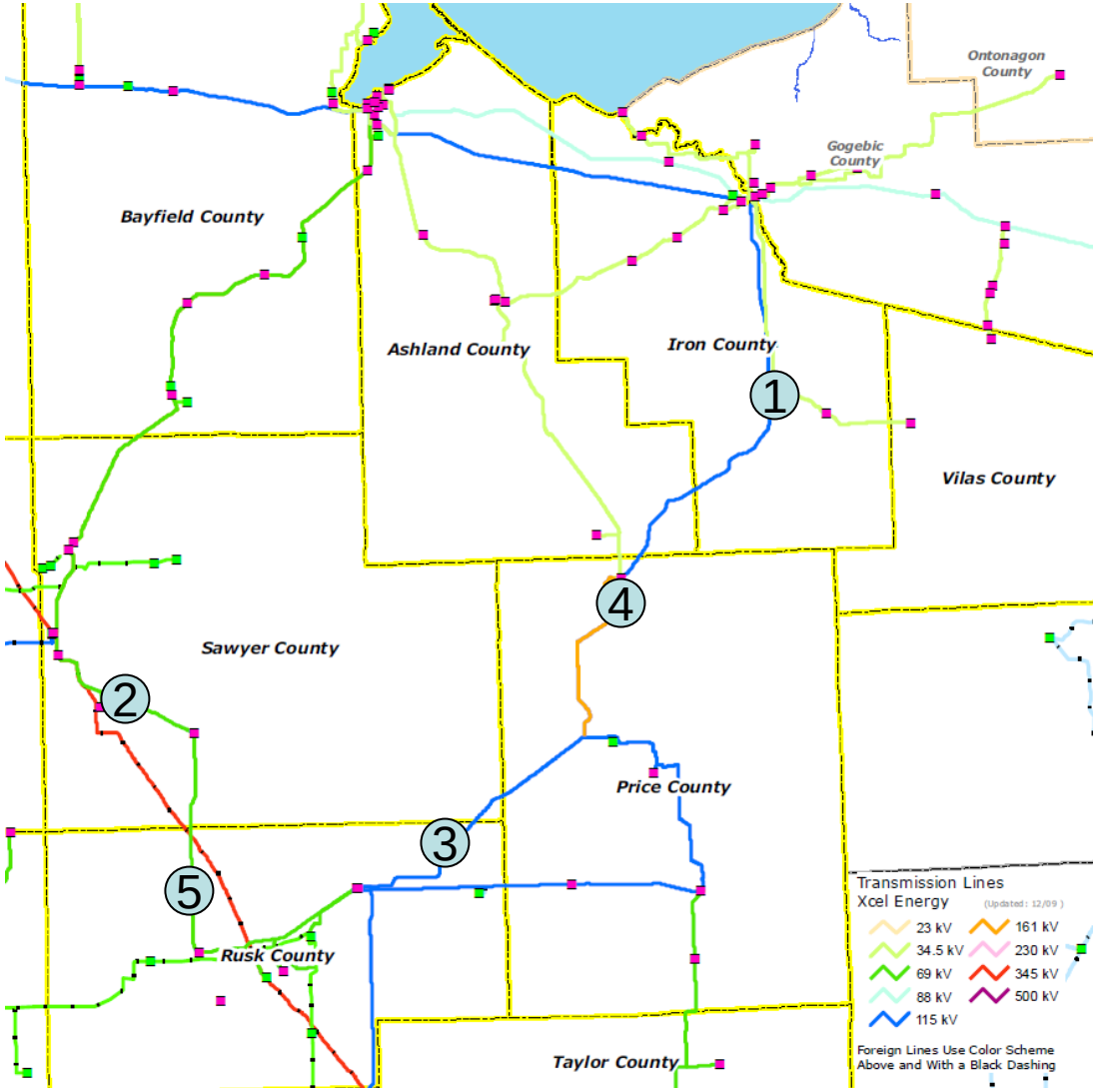
Zone 5: Northern Wisconsin Area



- **Eau Claire is the largest load center in the area.**
- **Primarily rural load.**
- **Minimal small customer load growth**
- **Major transmission expansion under construction in Eau Claire**
- **Issues**
  - Northern Wisconsin transmission maxed out
  - Substantial major industrial expansion under consideration in northern Wisconsin

Proposed Transmission Projects

Zone 5: Northern Wisconsin Area (2010-2014)

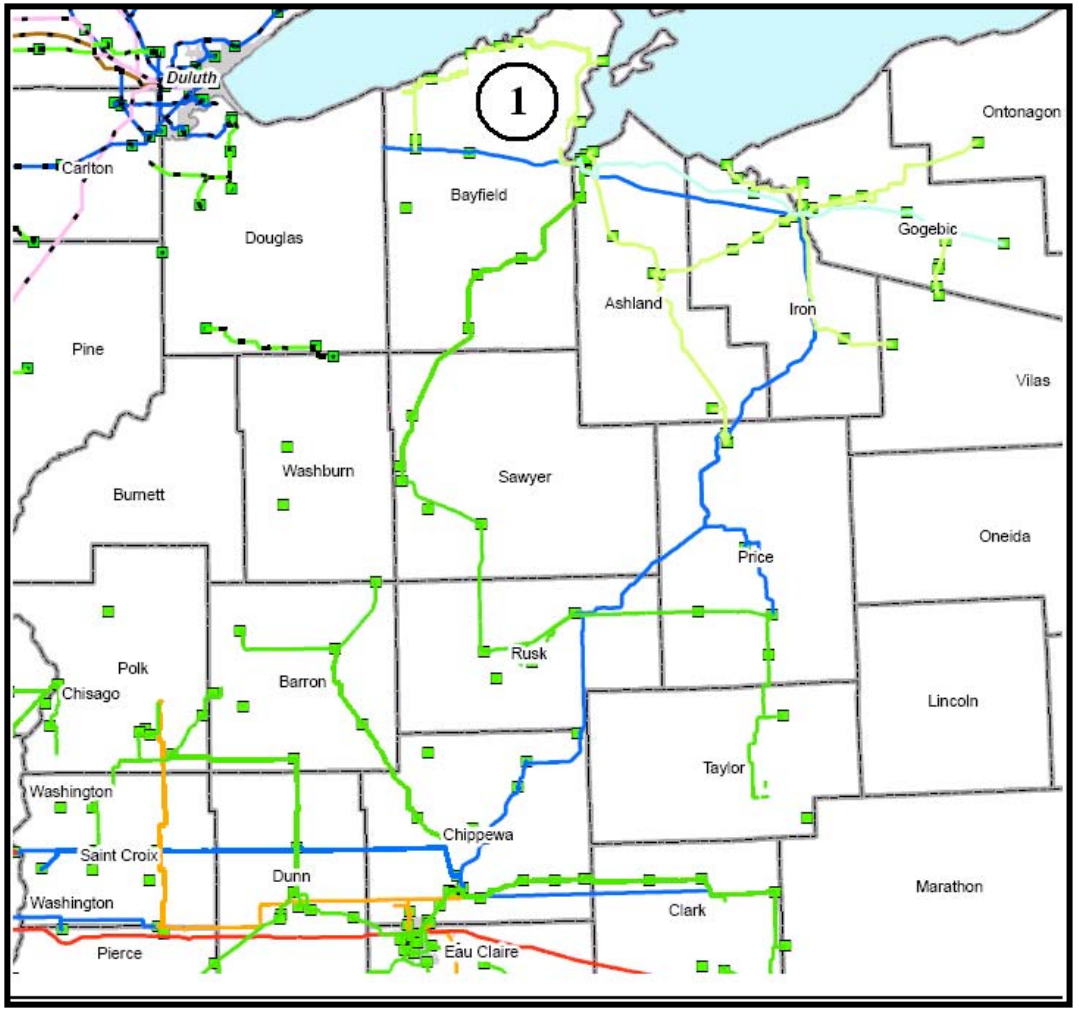


#	Project	Comments	ISD	Drivers
1	Weber lake Substation	A new 115/34.5 kV substation on 115 kV line between Park falls and Ironwood.	2012	Reliability
2	Stone Lake-Couderay 161 kV line	New 161 kV substation and line from Stone Lake-Couderay		Reliability
3	Osprey – Park Falls Rebuild	Rebuild 1922 lattice structures and string larger conductor	2012	Reliability
4	Park Falls Bio-Refinery connection	115 kV radial line from Park Falls sub to substantial new customer	2012	Reliability
5	Couderay – Osprey 161 kV line	Extension of Stone Lake – Couderay to support increased pumping loads	2014	Reliability

Note: Project scope and timing subject to change

Proposed Transmission Projects

Zone 5: Northern Wisconsin Area (2015-2019)

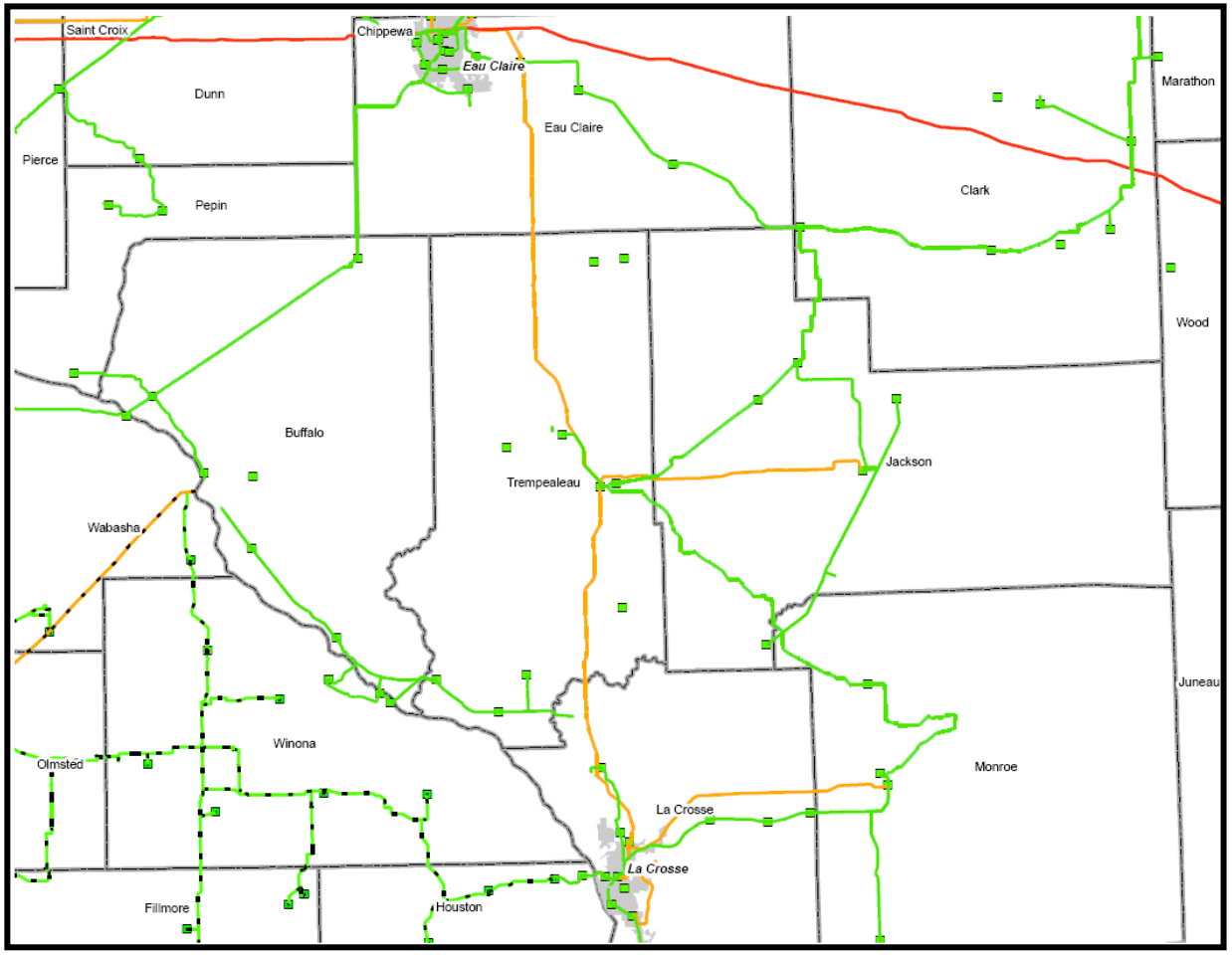


#	Project	Comments	Drivers
1	Bayfield Loop 115 kV	Rebuild existing Iron River – Gingles 34.5 kV loop to 115 kV with some Distribution underbuild	Load Shed

Note: Project scope and timing subject to change

Proposed Transmission Projects

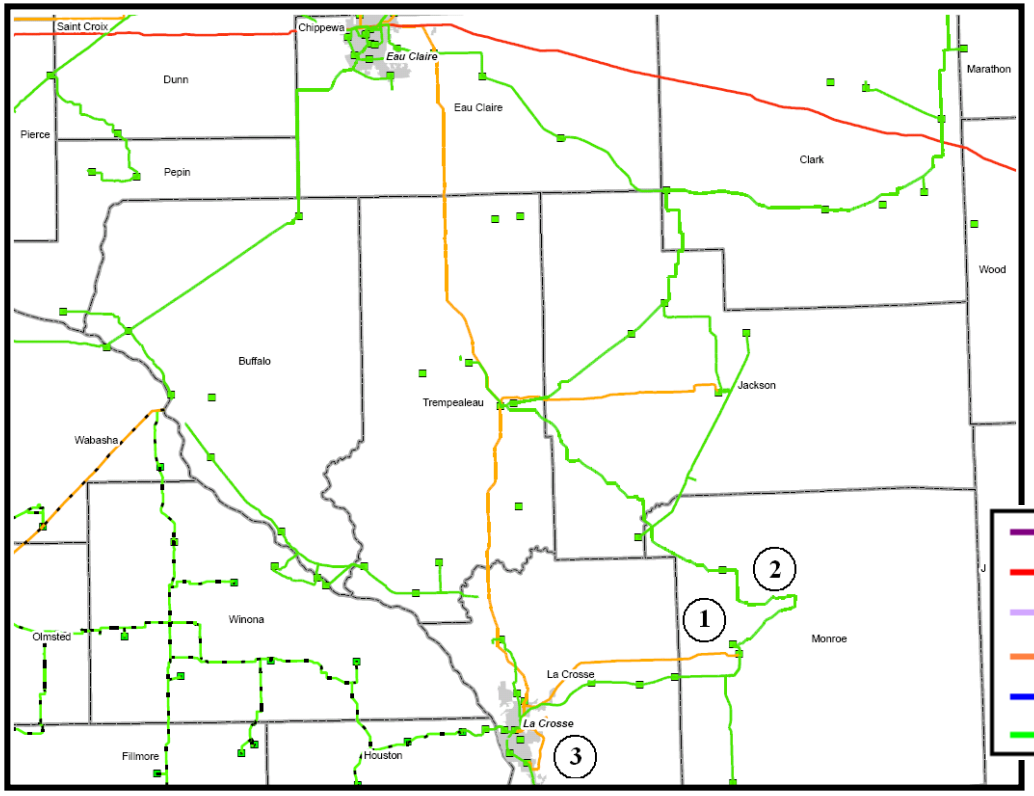
Zone 6: Southern Wisconsin Area



- **Lacrosse is the largest load center in the area.**
- **Made up of agricultural and smaller communities.**
- **CAPX 2020 creates a bulk supply source to the city of La Crosse in 2015.**
- **NSP System highly interconnected with Dairyland Power Coop in this area**

Proposed Transmission Projects

Zone 6: Southern Wisconsin Area (2010-2014)

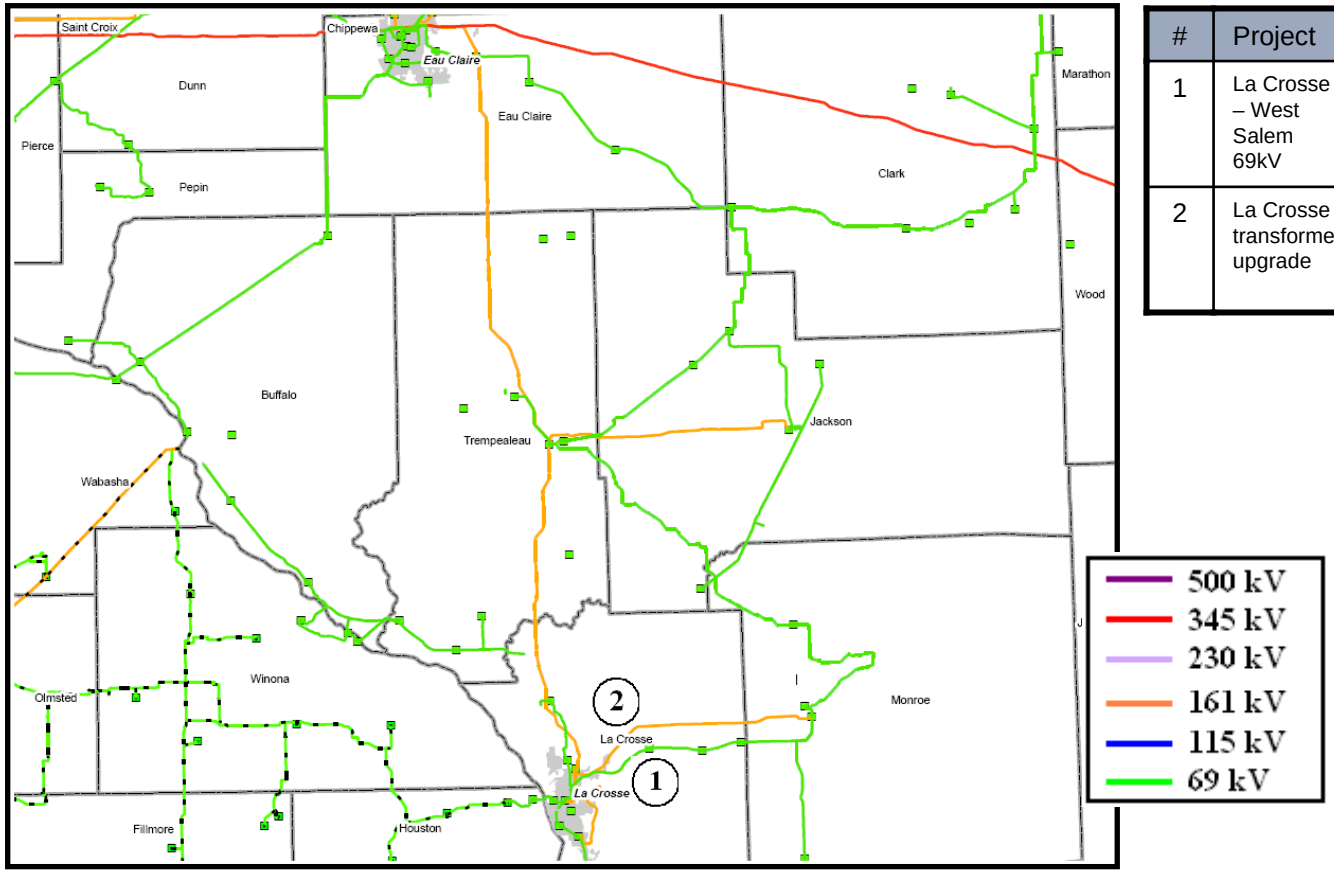


#	Project	Comments	ISD	Drivers
1	New transformer at Monroe County	Monroe County new 70 MVA 161/69kV transformer, including new breakers	2011	Reliability
2	Camp McCoy – Cataract 69 kV line rebuild	Rebuild 4 miles of 1/0 ACSR 69 kV line to 477 ACSR	2011	Reliability
3	Coulee transformer upgrade and ring bus	Replace Coulee 161/69kV transformer #5 with 112 MVA unit	2011	Reliability

Note: Project scope and timing subject to change

Proposed Transmission Projects

Zone 6: Southern Wisconsin Area (2015-2019)

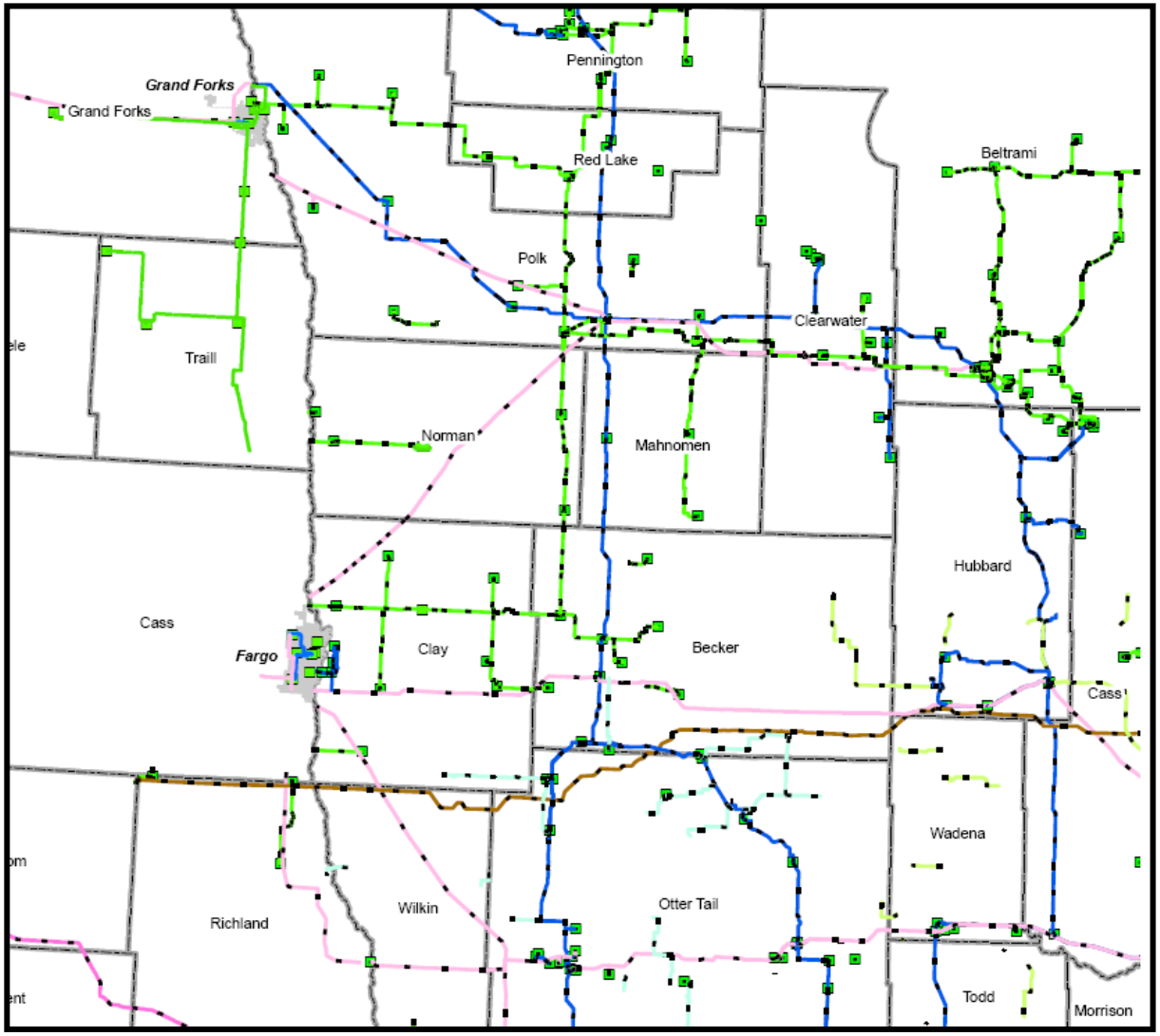


#	Project	Comments	ISD	Drivers
1	La Crosse – West Salem 69kV	Rebuild La Crosse to West Salem 69kV line to 477 ACSS	2016	Reliability
2	La Crosse transformer upgrade	Replace La Crosse 161/69kV transformer #2 with 112 MVA unit	2016	Reliability

Note: Project scope and timing subject to change

Proposed Transmission Projects

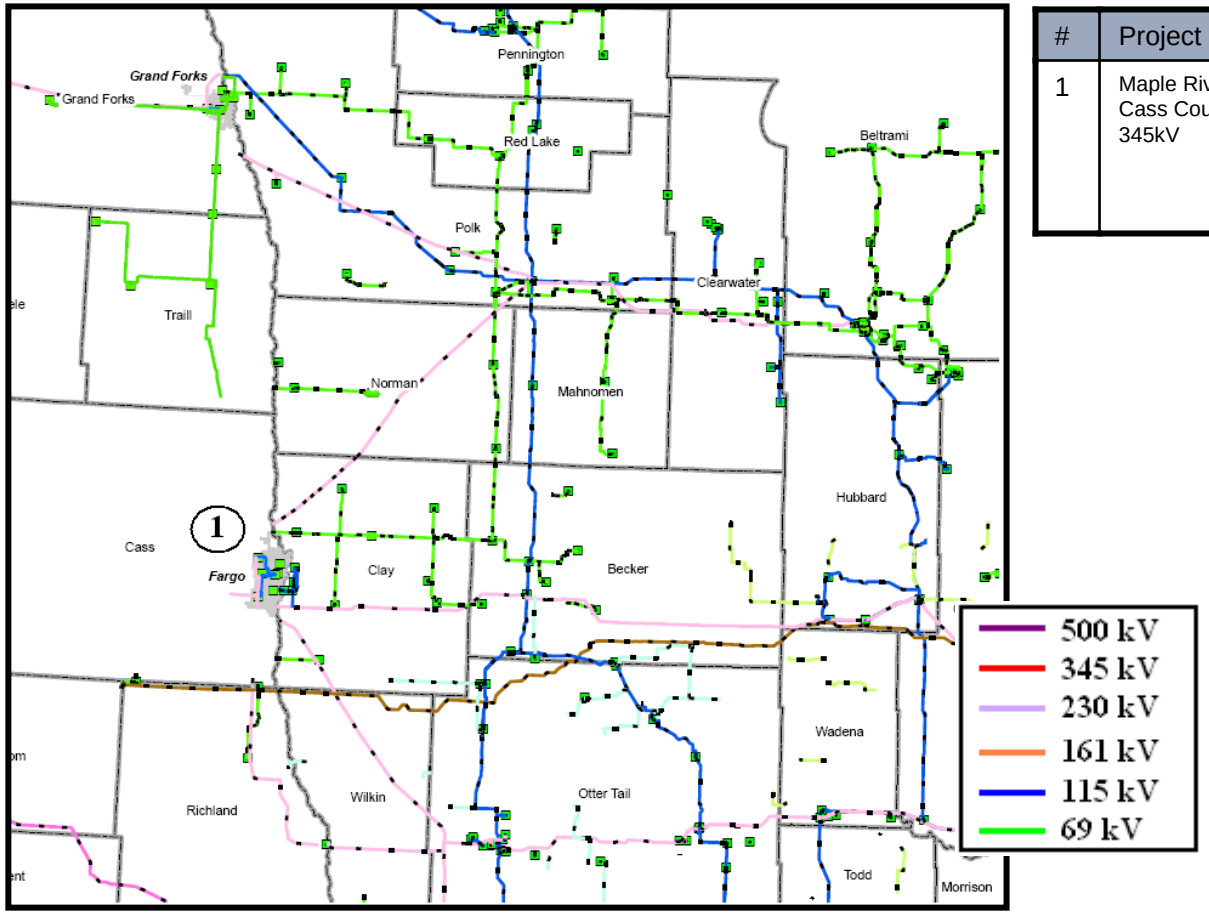
Zone 7: North Dakota Area



- **Fargo and Grand Forks are the primary load centers.**
- **New Bison substation for the CAPX Group 1 projects**
- **Issues**
  - Large amounts of wind proposed west of Fargo in North Dakota

Proposed Transmission Projects

Zone 7: North Dakota Area (2010-2014)

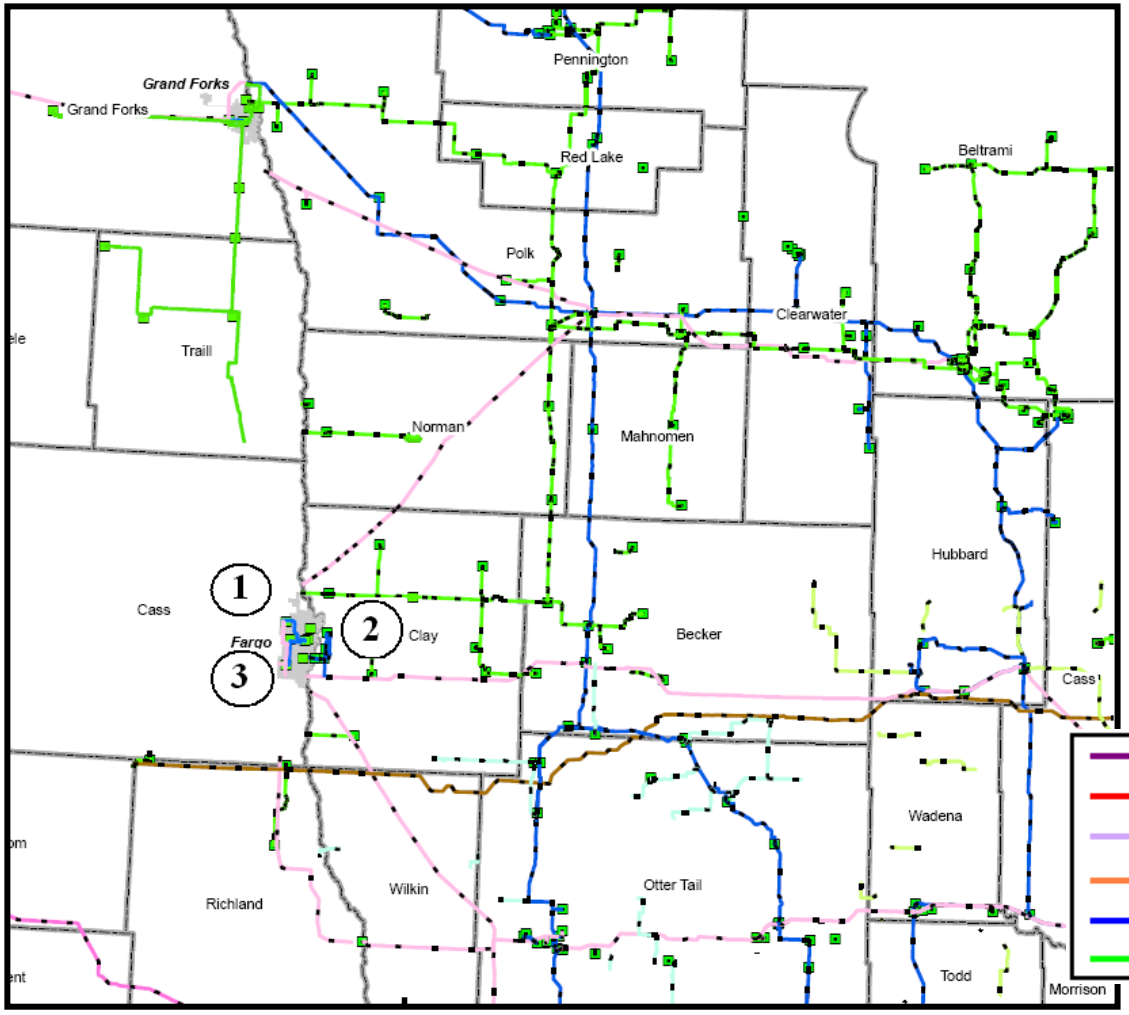


#	Project	Comments	ISD	Drivers
1	Maple River – Cass County 345kV	Maple River – Cass County, new 345kV line (operated at 230kV) and Cass County 230/115kV transformer		Reliability

Note: Project scope and timing subject to change

Proposed Transmission Projects

Zone 7: North Dakota Area (2015-2019)

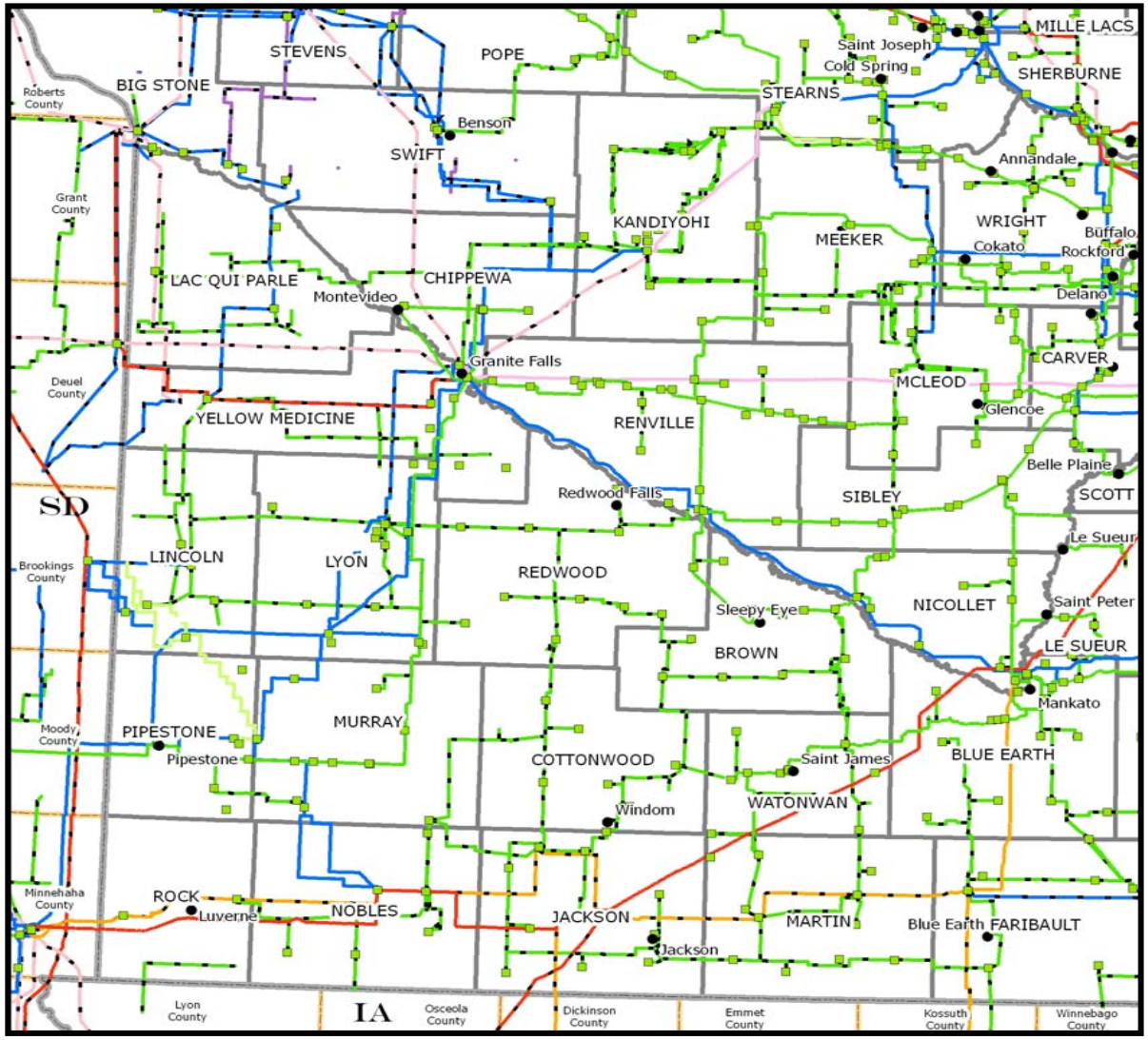


#	Project	Comments	Drivers
1	Maple River – Cass County 345kV extension	Extend Maple River – Cass County 345 kV Line to Flint Substation (via double-circuit with Maple River – Sheyenne 230 kV line)	Reliability
2	Cass County – Red River 115kV	Cass County to Red River 115kV, upgrade to 795 ACSS	Reliability
3	Maple River – Cass County – Flint 230kV	Maple River – Cass County – Flint 230 kV line, convert to 345 kV	Reliability

Note: Project scope and timing subject to change

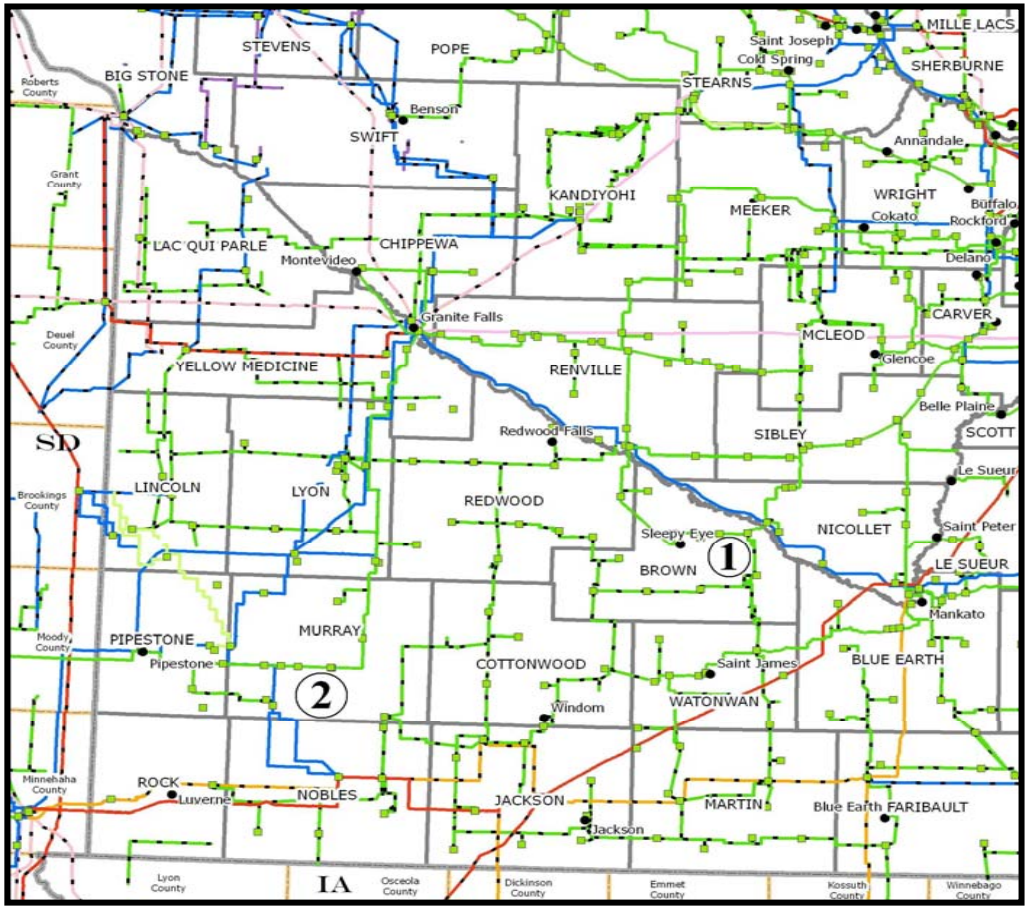
Proposed Transmission Projects

Zone 8: Minnesota Valley Area



- **Mankato is the primary load center**
- **New Helena substation for the CAPX 2020 Group 1 projects**
- **Issues**
  - Local load serving
  - Wind interconnection interest
- New 345/115/69 kV substation is planned between Wilmarth and Helena substations for load serving purposes. The proposed in-service date for this project is 2012

Proposed Transmission Projects
Zone 8: Minnesota Valley Area (2010-2014)

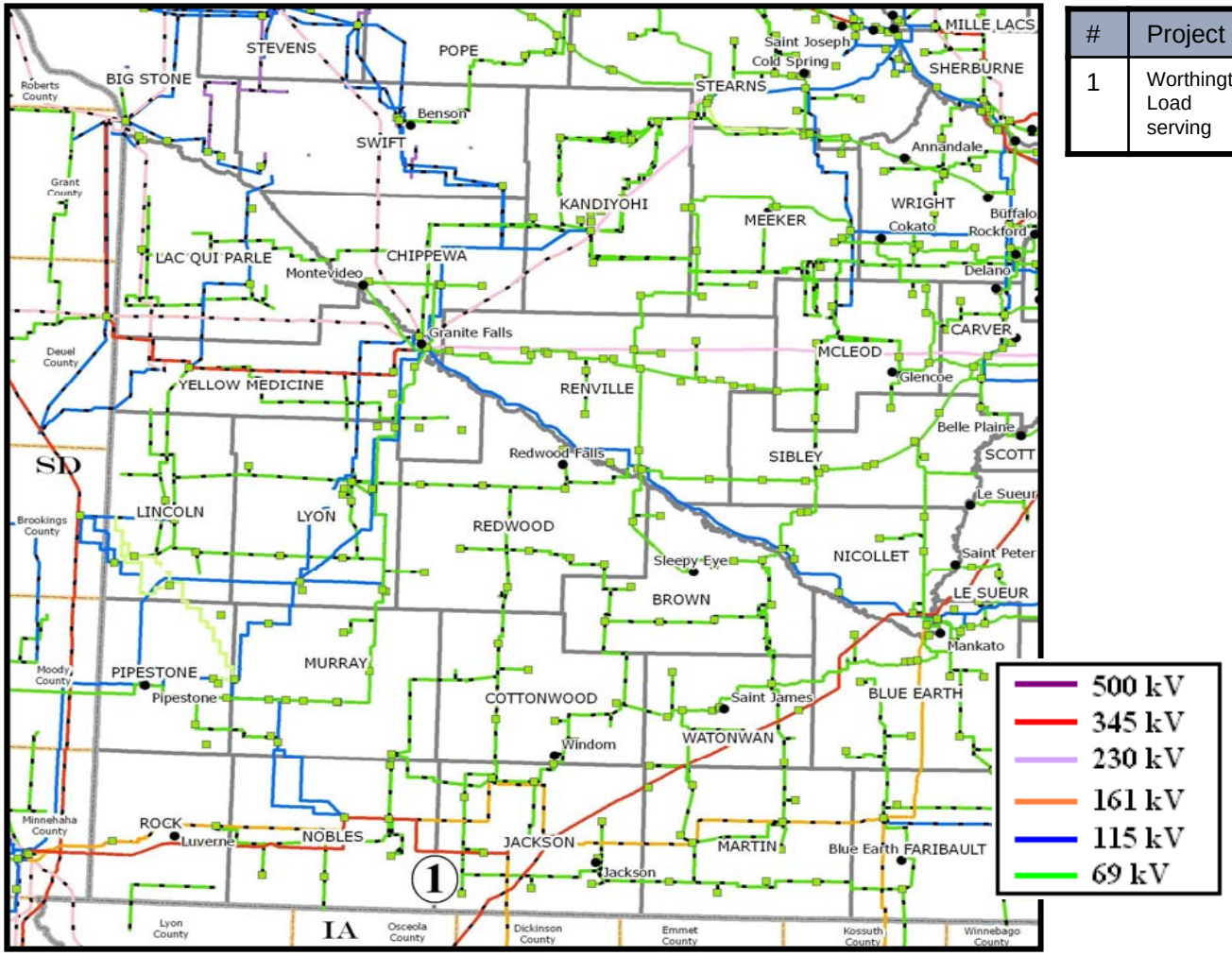


#	Project	Comments	ISD	Drivers
1	Fenton 69 kV interconnection	New 69 kV in and out at Fenton	2010	Reliability

500 kV
345 kV
230 kV
161 kV
115 kV
69 kV

Note: Project scope and timing subject to change

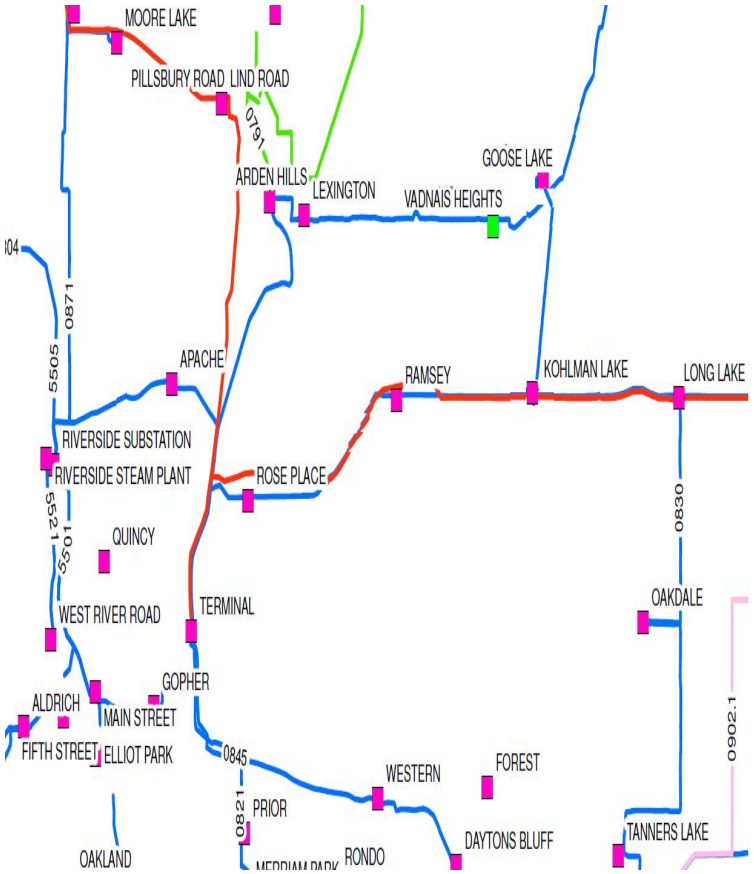
Proposed Transmission Projects
Zone 8: Minnesota Valley Area (2015-2019)



#	Project	Comments	Drivers
1	Worthington Load serving	Possible new 161/115 kV or 115/69 kV source at Nobles	Reliability

Note: Project scope and timing subject to change

St. Paul Northern suburbs



- Large loads in this area are at Apache, Arden Hills, Lexington and Goose Lake.
- Several contingencies would require shedding load to comply with TPL-003 standard requirements.
- The plan requires
  1) adding 2nd 345/115 kV transformer at Chisago County.

  2) Upgrading Apache – Riverside line to higher capacity

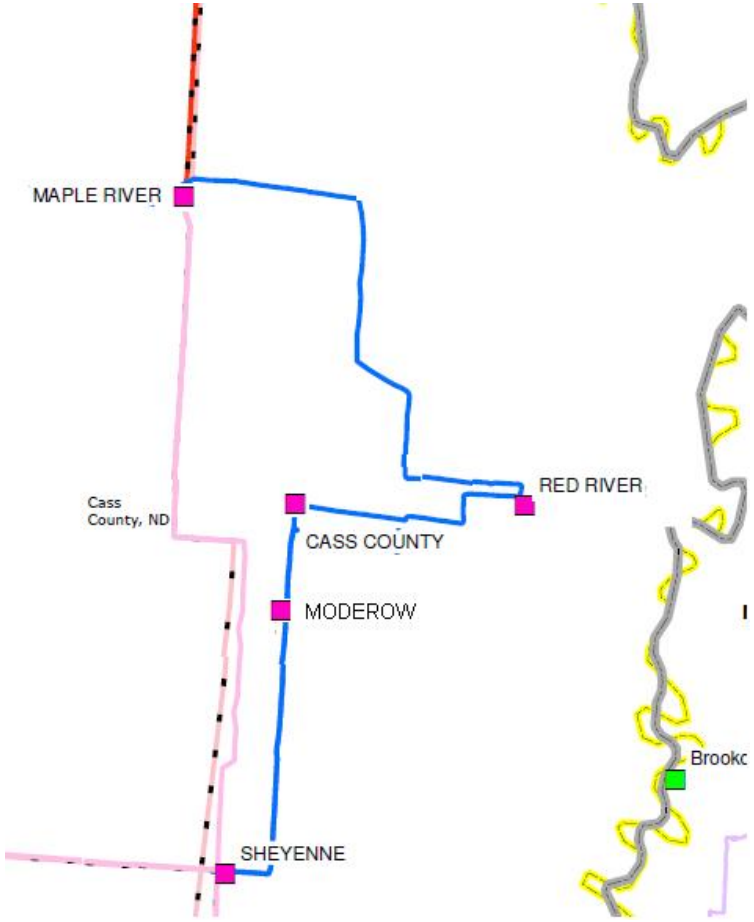
  3) Convert Goose Lake – Kohlman Lake115 kV line to double circuit.

  4) Convert Kohlman Lake – Long Lake 115 kV line to double circuit.

Minnesota Valley Area

- This area is mostly impacted by High flows due to proximity of wind resources.
- The existing loads in this area would need to be shed after n-1 conditions to meet NERC TPL-003 standard.
- The proposed plan is to upgrade 27 miles of Minnesota Valley – Maynard – Kerkhoven tap line to higher capacity by 2014.

Fargo Area



- The largest loads in this area are Sheyenne, Cass County and Moderow substations served by the 115 kV lines in the area
- Several transmission contingencies would require shedding load during peak and off peak conditions to meet NERC TPL-003 standard
- The proposed plan is to build 0.5 miles of double circuit 345 kV (operated at 230 kV) line into Cass County substation, and install a 230/115 kV transformer at Cass County.
- Alternatively a new 345 kV line from Maple River to Cass County substation with 345/115 kV transformer at Cass County is also being considered.

20-Year Scenario Assessment

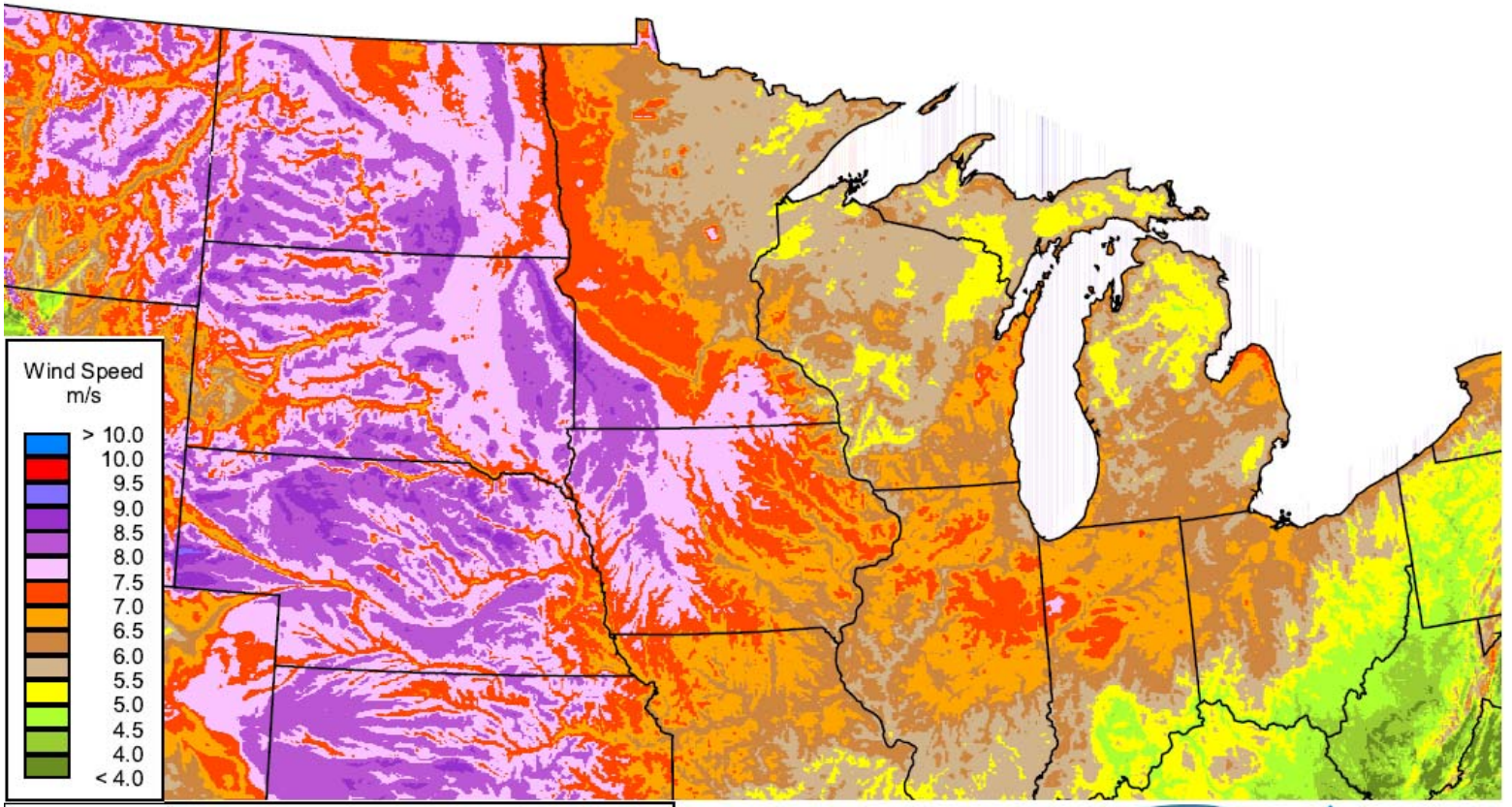
20-Year Scenario Assessment

- Assessment of transmission needs in NSP area for potential future renewable policies
- 4 scenarios based on possible upper Midwest renewable energy policies and generation patterns
- EHV overlay address potential national renewable policy

20-Year Scenario Assessment Analysis

- Resource availability
  - Variety of potential locations for new generation resources
    - Most likely to develop outside the Twin Cities metropolitan area.
  - Assumed new nuclear power plants on NSP system unlikely during next 20 years
  - Assumed small scale distributed generation will continue in their present role in resource or transmission needs
  - Solar technology is starting to be installed, but will likely develop in the sunnier American southwest

Wind Resource Map



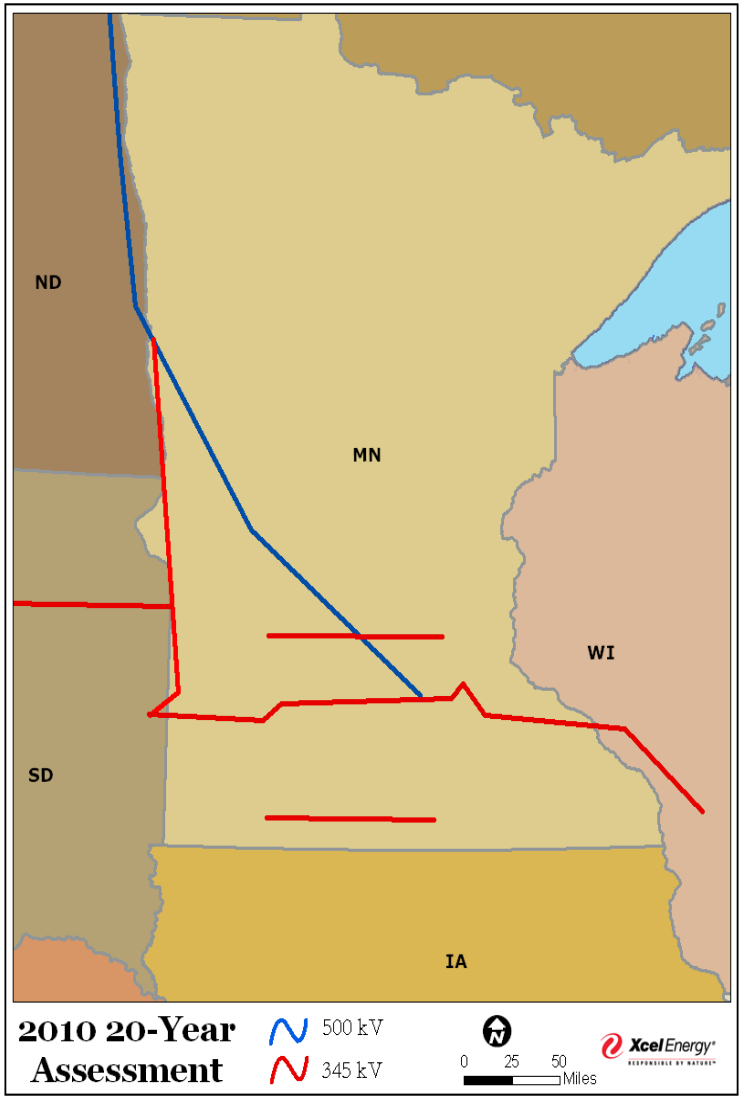
Source: Wind resource estimates developed by AWS Truewind, LLC for windNavigator® Web: http://navigator.awstruewind.com | www.awstruewind.com. Spatial resolution of wind resource data: 2.5 km. Projection: Albers Equal Area WGS84.

AWS Truewind

NREL National Renewable Energy Laboratory
Innovation for Our Energy Future

28-JAN-2010 4.1.1

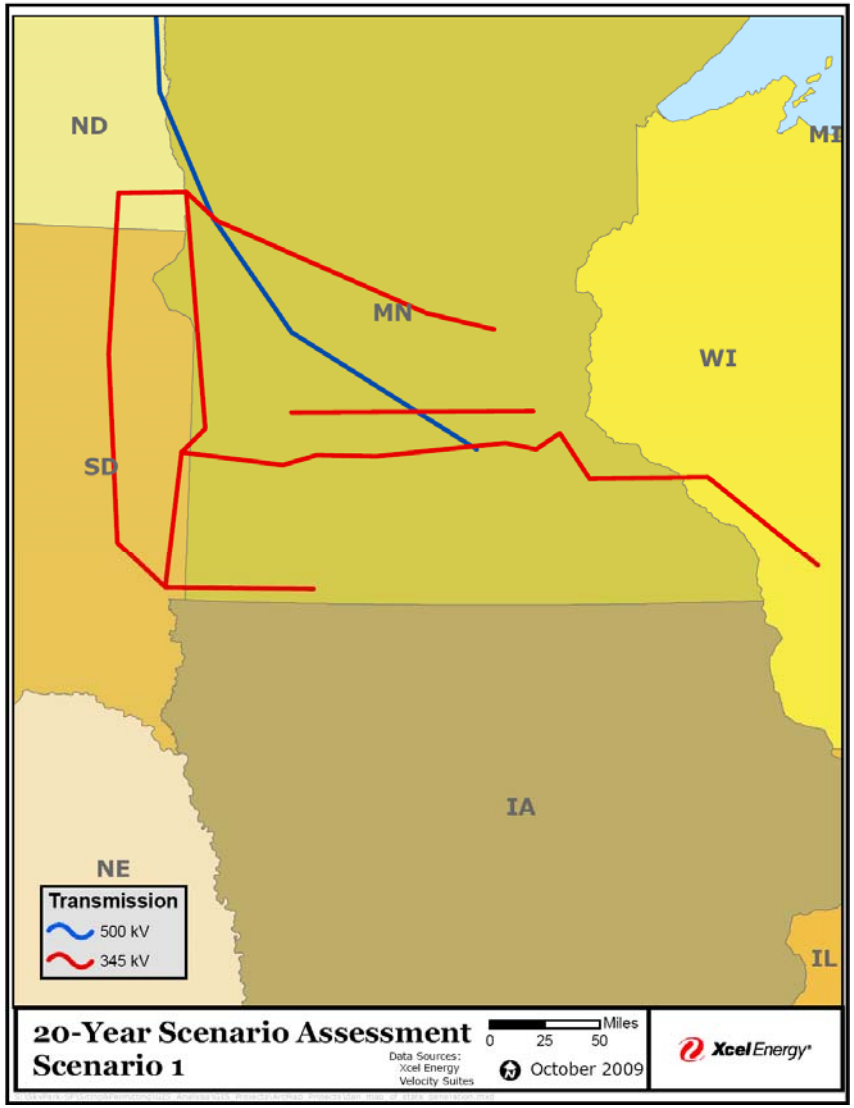
2010 20-Year Vision Plan



- 2010 Vision Study was localized to the NSP region
- For the 20-Year Vision Plan the facilities shown were verified to still be the next likely transmission buildout.
- The facilities were common to all generation scenarios studied
- The following slides describe the 2009 Bridge Study analysis which was a broad regional 20-year vision plan

2009 Bridge Study Strategic Vision: Scenario 1

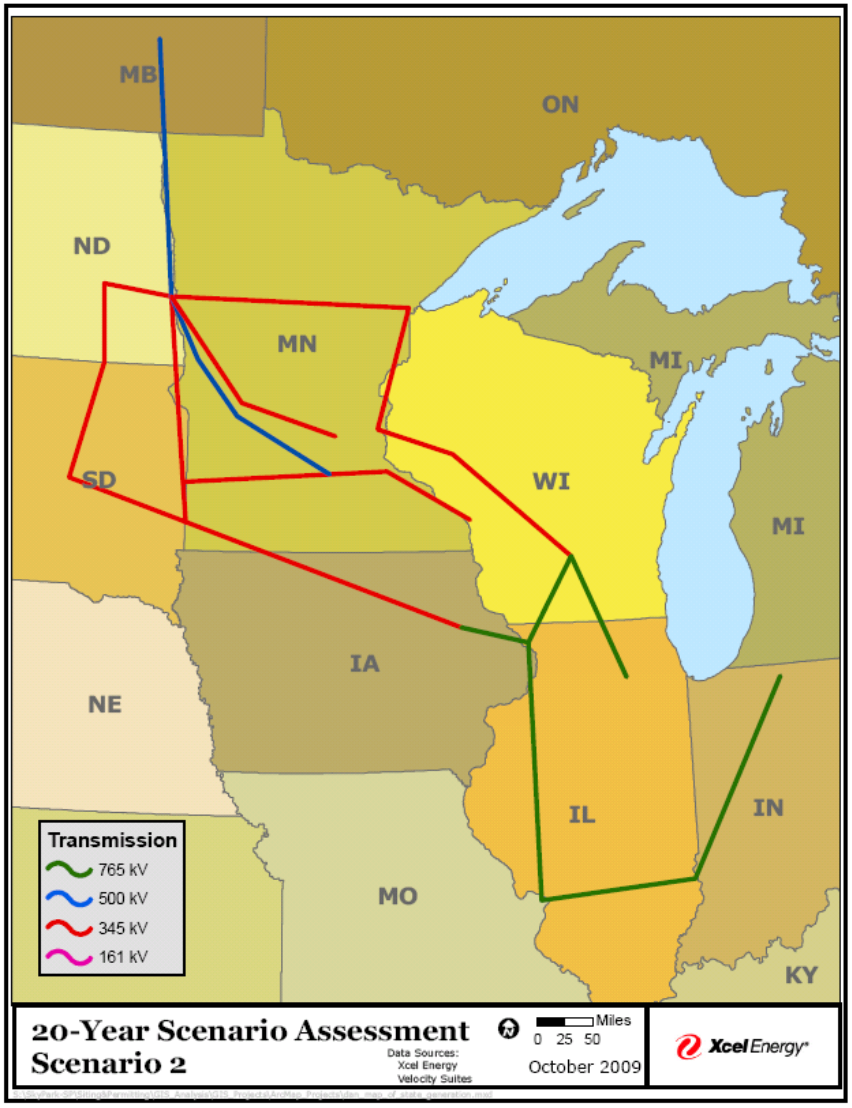
High Internal Renewable



- **Scenario 1-- High Minnesota only renewable development**
  - Normal load growth
  - Minnesota will continue RES obligation
  - Surrounding states do not expand above their present minimal RES obligations, or develop internally and require no delivery from Minnesota or North and South Dakota
- **Statistics**
  - 1,100 miles of 345 kV double circuit
  - 110 miles of 500 kV
  - Total estimated cost of: ~$4 billion

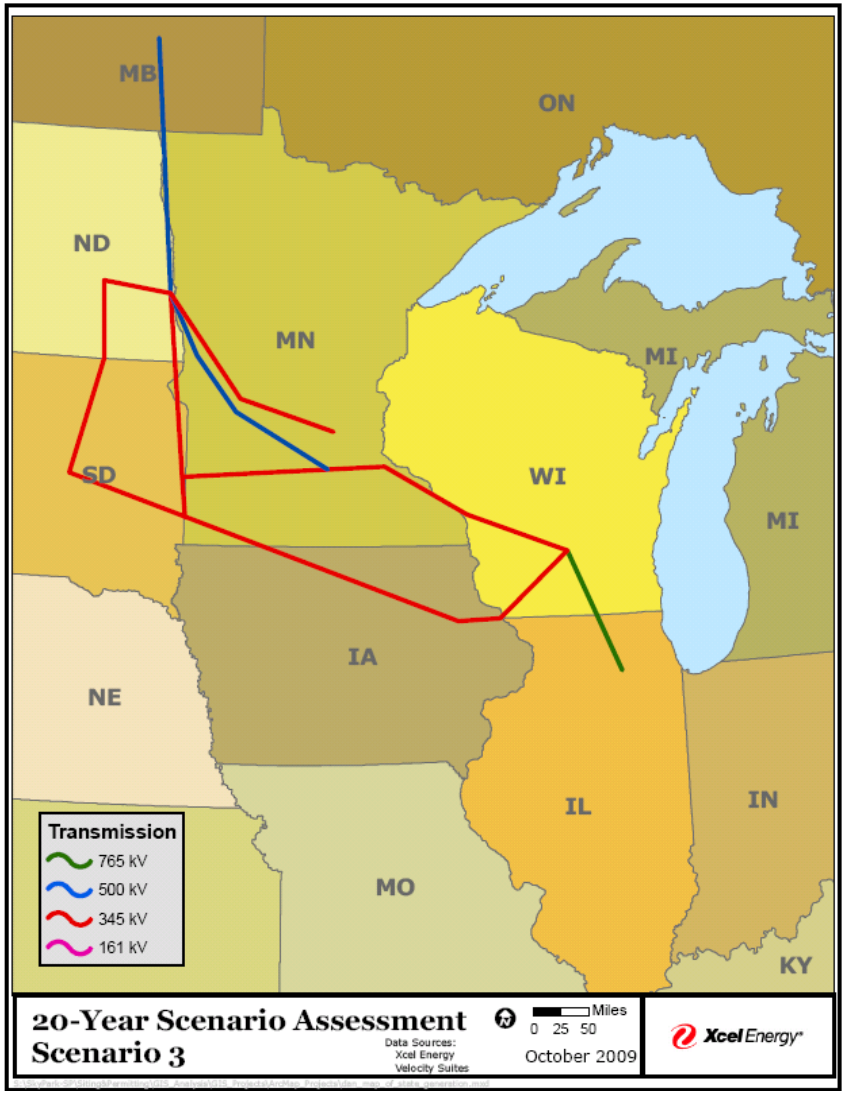
2009 Bridge Study Strategic Vision : Scenario 2

Sub-Regional Renewable



- **Scenario 2-- Sub-Regional renewable development**
  - Normal load growth
  - Upper Midwest (MN, WI, IA, ND, SD) all develop an obligation similar to the MN RES
  - States outside the Upper Midwest also expand on or initiate their present renewable obligations
- **Statistics**
  - 1,200 miles of 345 kV double circuit
  - 110 miles of 500 kV
  - 730 miles of 765 kV
    - Total estimated cost of: ~$6.7 billion

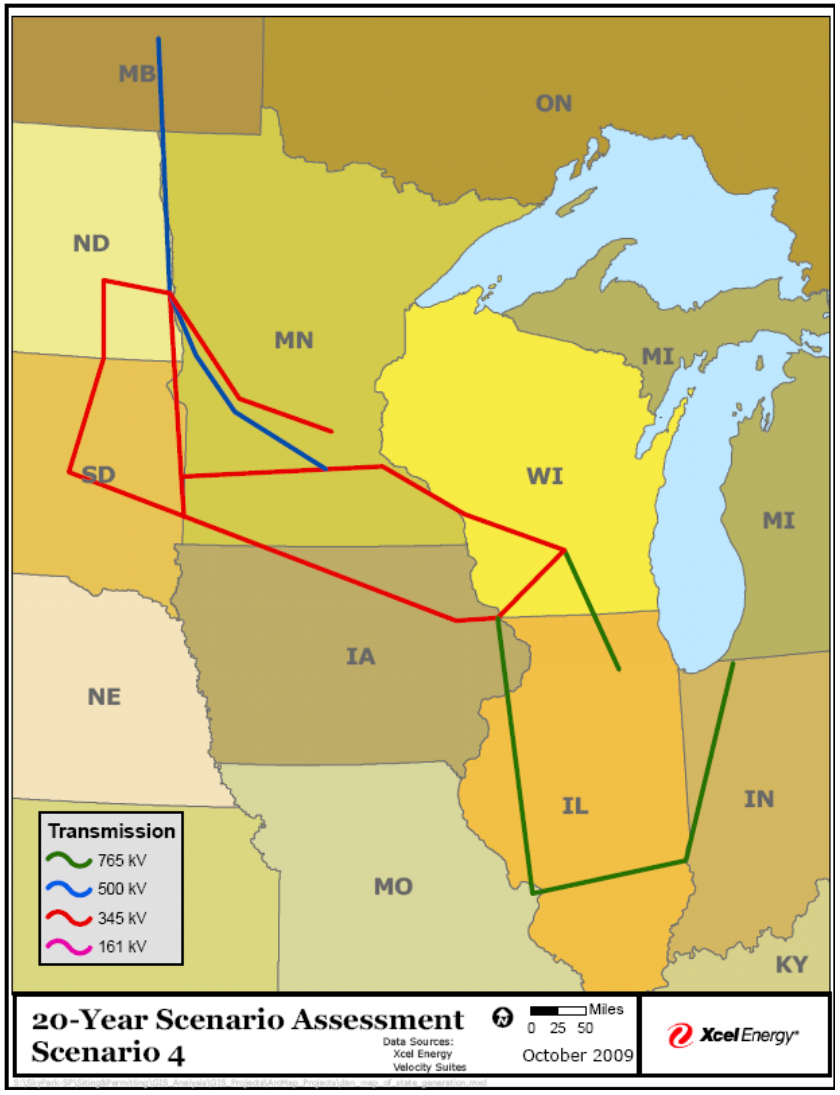
2009 Bridge Study Strategic Vision : Scenario 3
Non Renewable Long Range



- **Scenario 3 -- Non-renewable long-range future**
  - Scenario 1, with the same renewable expansion through the year 2016
  - Beginning in 2017, assume RPS requirements in Western MISO and throughout Eastern Interconnect are scaled back
  - US does not initiate a carbon reduction initiative, Minnesota will repeal its coal plant moratorium
- **Statistics**
  - 1,000 miles of 345 kV double circuit
  - 110 miles of 500 kV
  - 100 miles of 765 kV
    - Total Estimated Cost of: ~ $4 billion

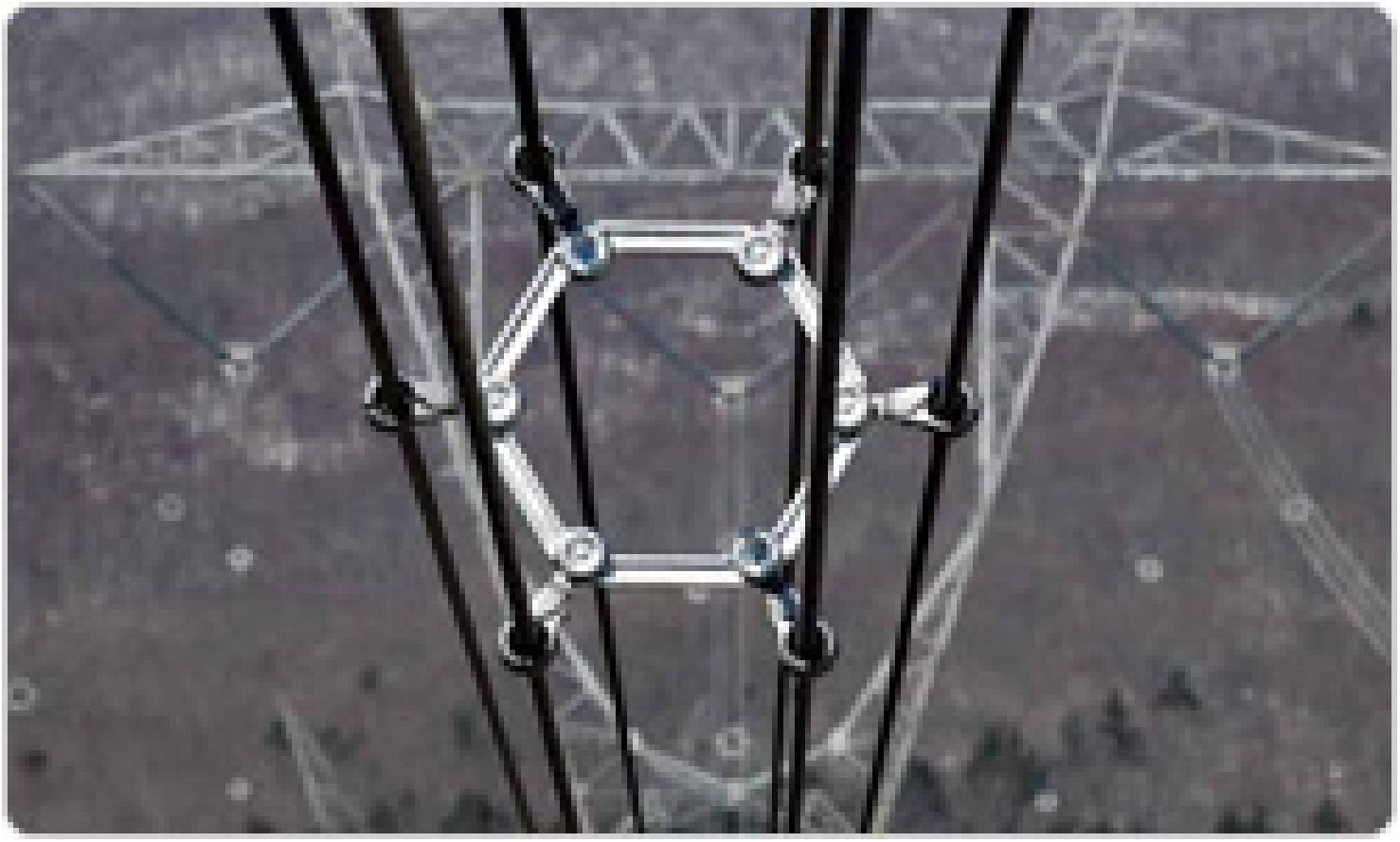
2009 Bridge Study Strategic Vision : Scenario 4

Low Load Growth



- **Scenario 4 — Low load growth**
  - Flat load growth
  - Upper Midwest (MN, WI, IA, ND, SD) all develop an obligation similar to the MN RES
  - States outside the Upper Midwest also expand on or initiate their present renewable obligations
  - Transmission similar to Scenario 2 due to the similar regional renewable expansion
- **Statistics**
  - 1,100 miles of 345 kV double circuit
  - 110 miles of 500 kV
  - 570 miles of 765 kV
  - Total Estimated Cost of: ~ $6 billion

Regional



Extra-High Voltage

Transmission Overlays

- NSP System situated between some of the nations best wind and potential central Midwest and Eastern load serving entities
- Potential National Renewable Energy Standard
- Potential “interstate highways” to ship great plains wind generation under study

Transmission Overlay

Proposals

- Various study/proposals
  - MISO Renewable Generation Outlet Study (RGOS 1 and 2)

    www.midwestiso.org/home
  - Green Power Express

    www.itctransco.com/projects/thegreenpowerexpress.html
  - SMARTransmission Study

    wwwqa.smartstudy.biz/
  - Joint Coordinated System Plan (JCSP)

    www.nyiso.com/public/services/planning/crpp.jsp

Transmission Overlay

Proposals

- NSP Involvement
  - NSP is participating in the overlay studies
    - To ensure the NSP system and local area are properly represented
    - To ensure customer focus, cost effectiveness, operational reliability and regional policymaker alignment
    - NSP believes it can best look out for these interests by directly participating in these studies.

RGOS (MISO) Study Scope

- Develop regional transmission system to support renewable portfolio standards
  - Phase I – Minnesota, Wisconsin, Illinois, and Iowa (approximately 15,000 MW)
  - Phase II – RPS increases in Phase I states and remaining MISO states not in Phase I (approximately 22,000 MW)
  - www.midwestiso.org/page/Expansion+Planning

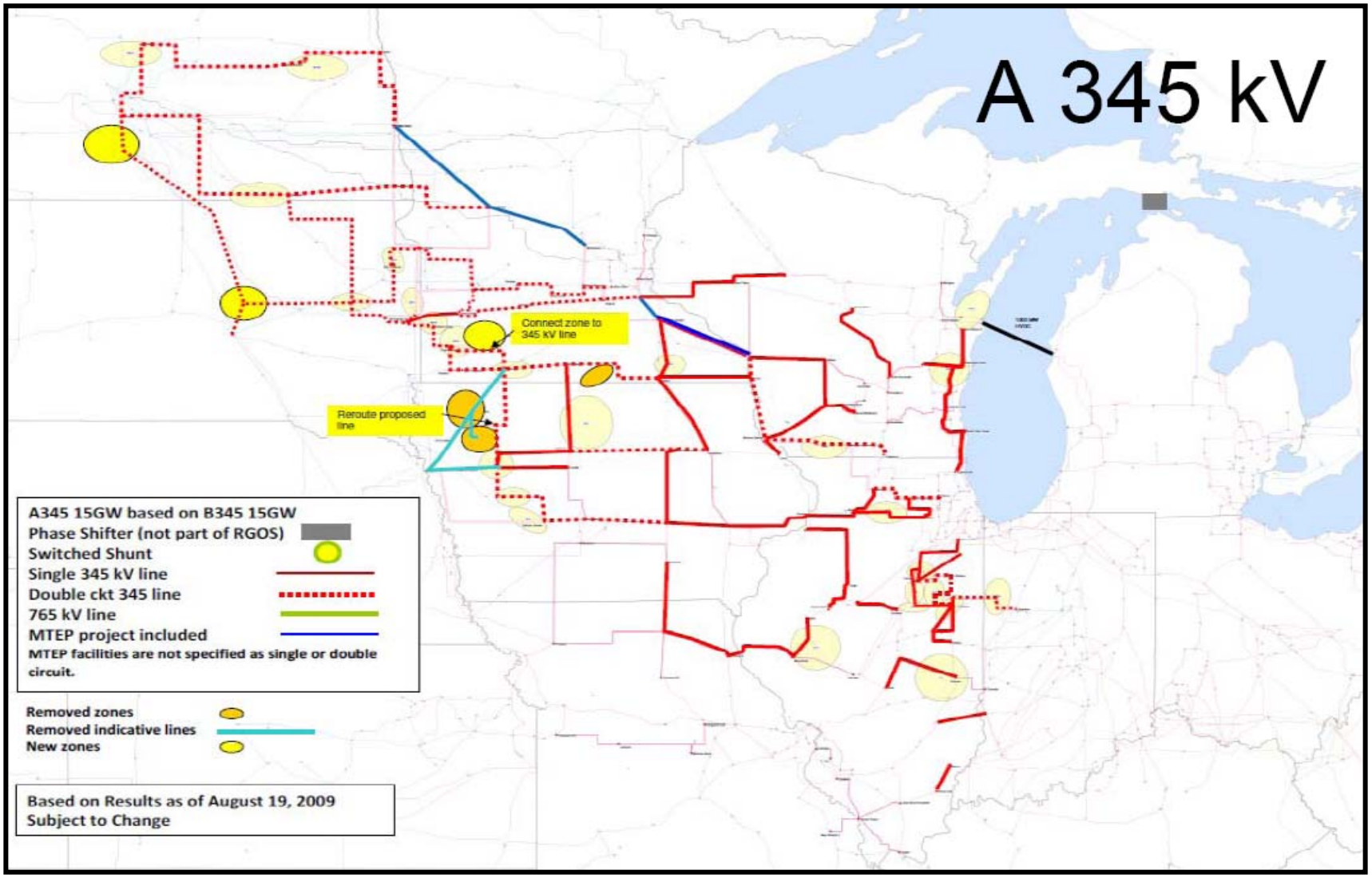
RGOS Wind Scenarios

- **Zones**
  - 20 energy zones within UMTDI plus additional 9 zones added in IL
  - UMTDI zones to serve UMTDI states, no export
  - IL zones to serve IL (Ameren, ComEd)
  - Zones established at 750MW-1500MW capacity each
  - Indicative scenarios used 18-22 zones

- **Two primary transmission build outs developed for each scenario based on indicative work**
  - 345 kV and 765 kV (with 345)

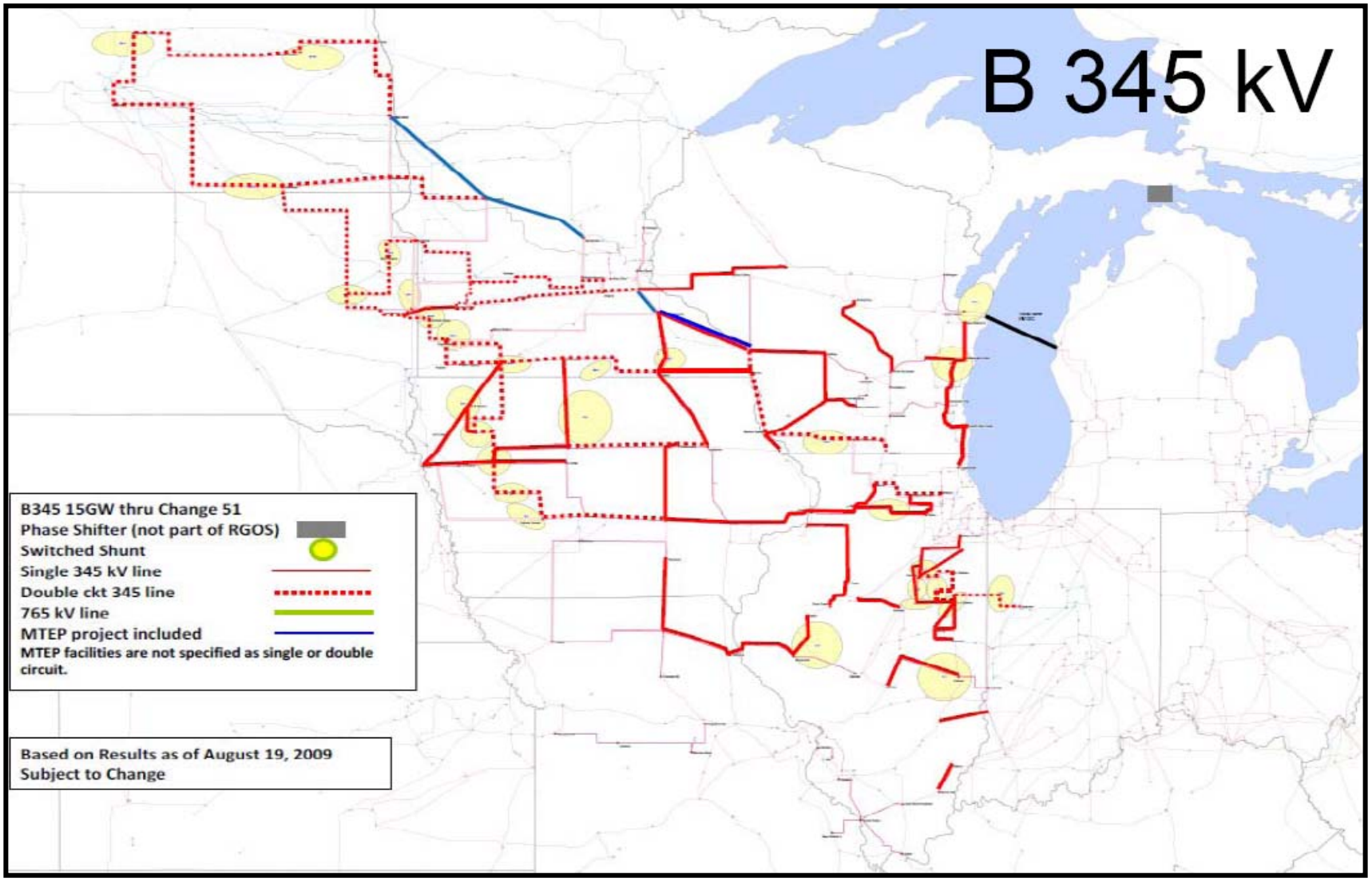
Scenario A	Scenario B
▪ Scenario has higher concentration of zones in the ND/SD compared to B	▪ Scenario has higher concentration of zones in MN/IA compared to A

15 GW Scenario A



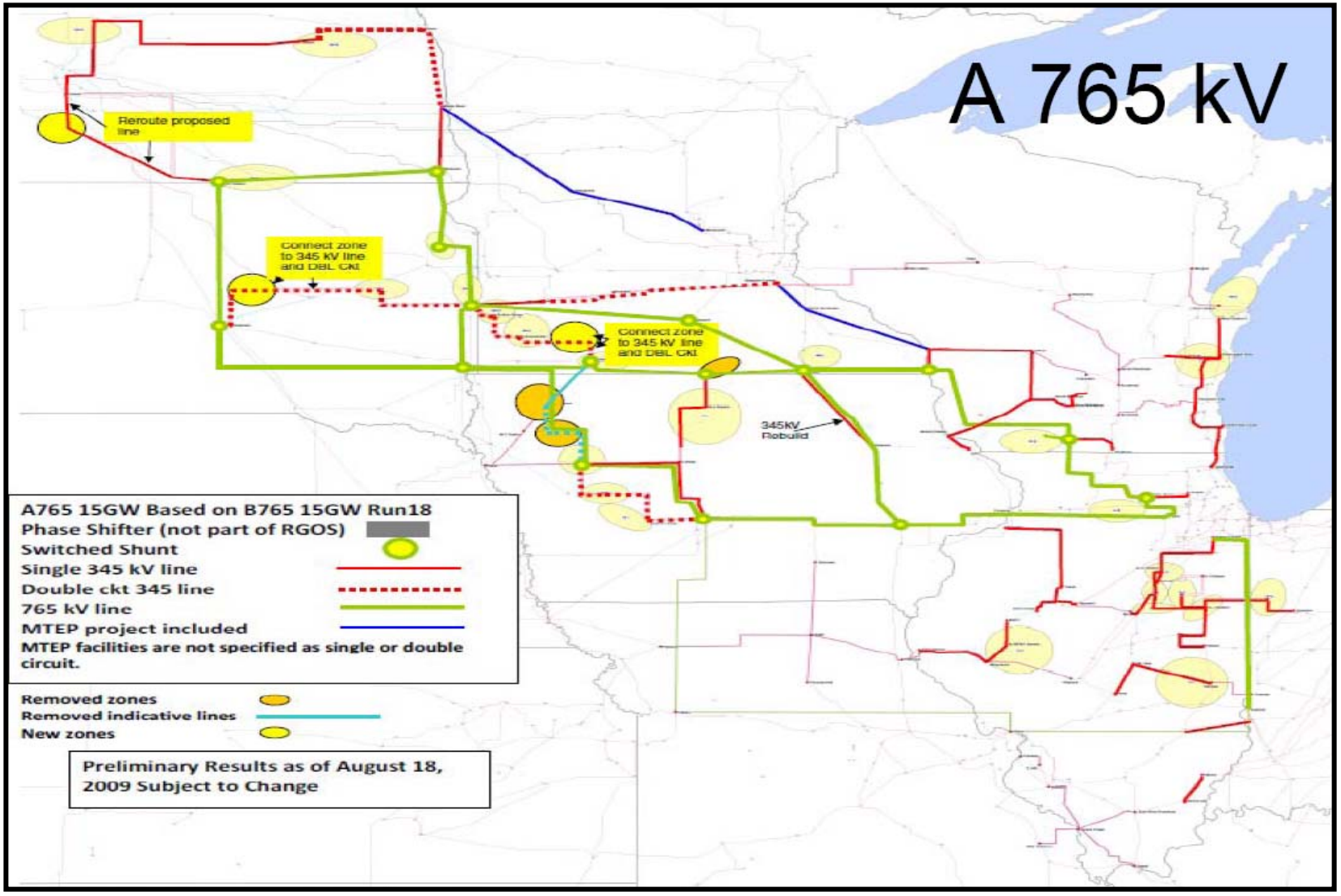
* MISO RGOS Phase I Study

15 GW Scenario B



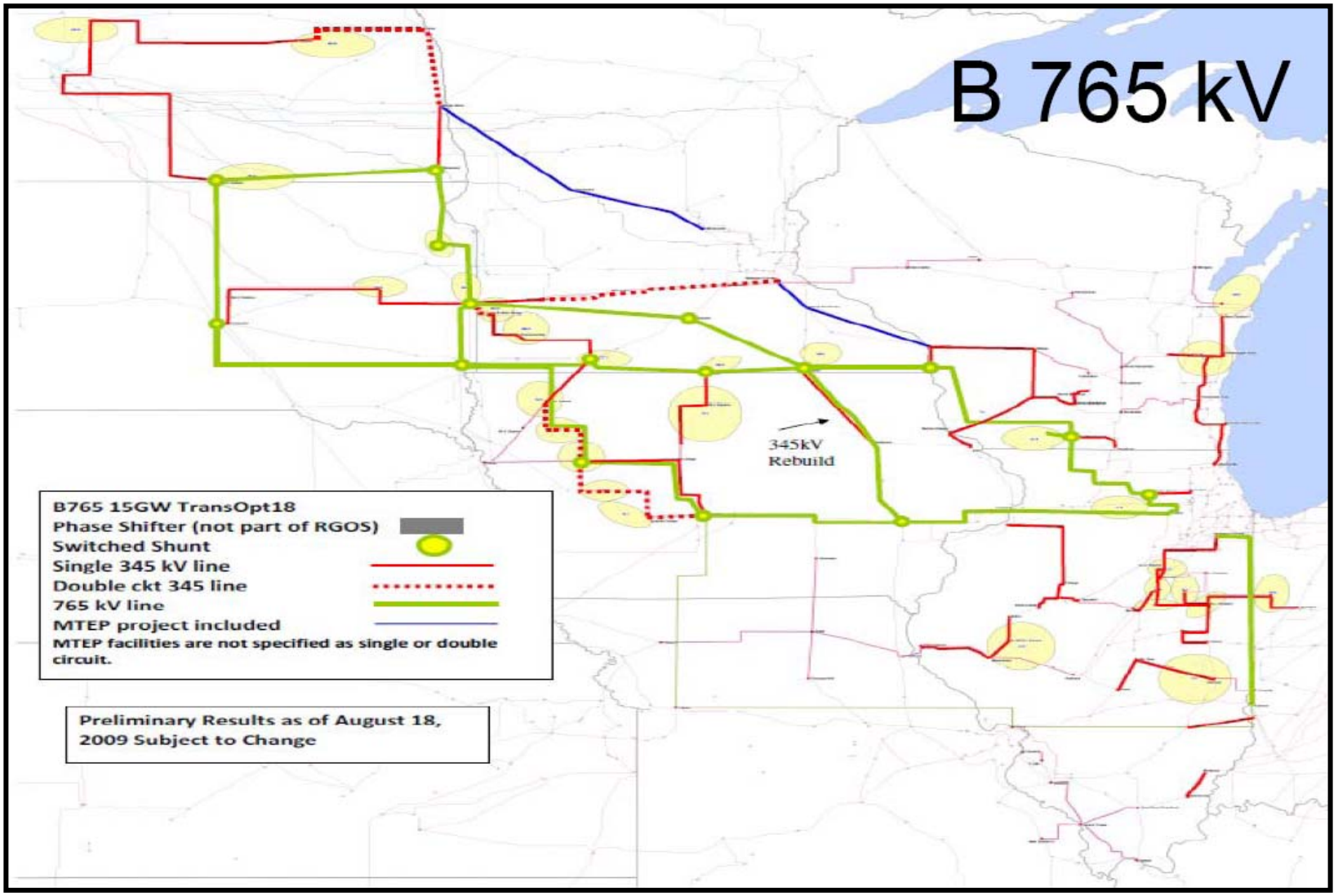
* MISO RGOS Phase I Study

25 GW Scenario A



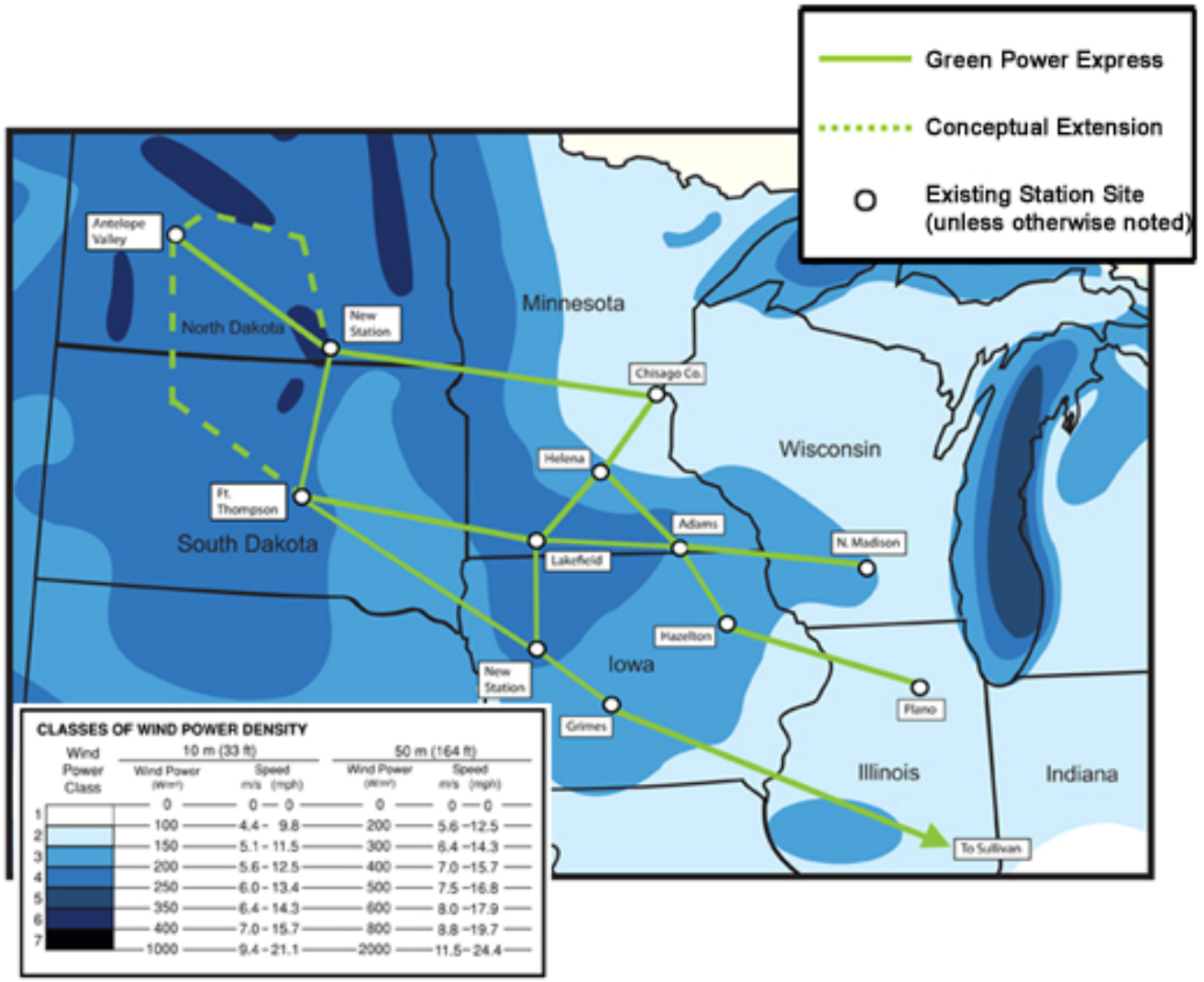
* MISO RGOS Phase I Study

25 GW Scenario B



* MISO RGOS Phase I Study

Green Power Express Proposal



* ITC's Green Power Express

Joint Coordinated System Plan

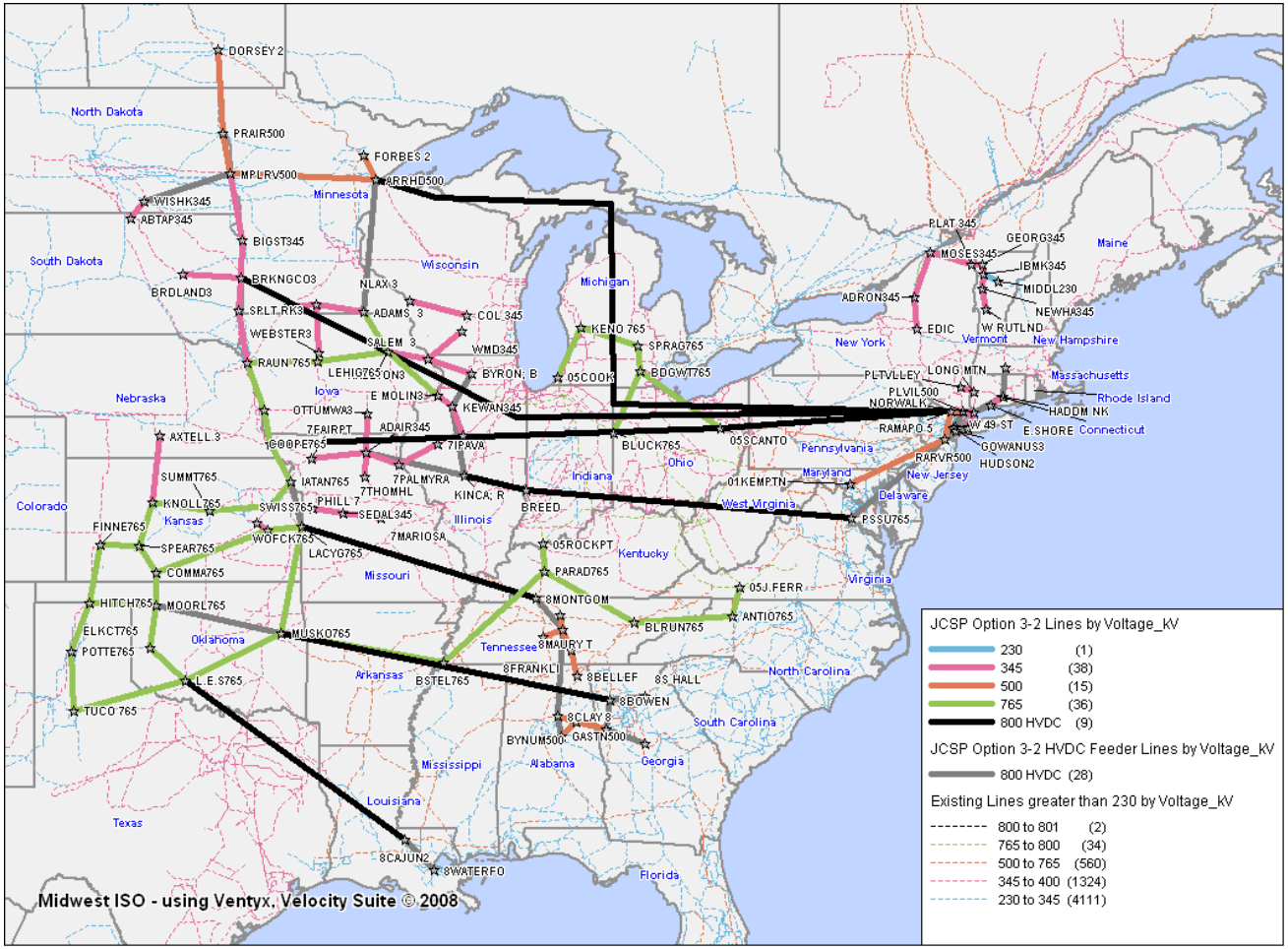


Figure 1-3: 20% Wind Energy Scenario Conceptual Transmission Overlay

(The Strategic Midwest Area Transmission Study)

SMARTransmission Study

- **Sponsors**: American Transmission Company, Electric Transmission America, LLC (American Electric Power and MidAmerican Energy Holding Co), Exelon, MidAmerican Energy, Xcel Energy and NorthWestern Energy
- **Purpose**: examine transmission infrastructure needed to support renewable energy development and transport to consumers in the Upper Midwest, the Ohio River Valley, and farther East.
- **Status**: Study report has been published.
  - www.smartstudy.biz

Links to additional information on

Transmission Plans

- The Minnesota Transmission Owners
  - www.minnelectrans.com
- The CAPX 2020 projects
  - www.capx2020.com
- The Midwest Independent Transmission System Operator, Inc. (MISO)
  - www.midwestiso.org
- Green Power Express
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